NOVEMBER, 1940

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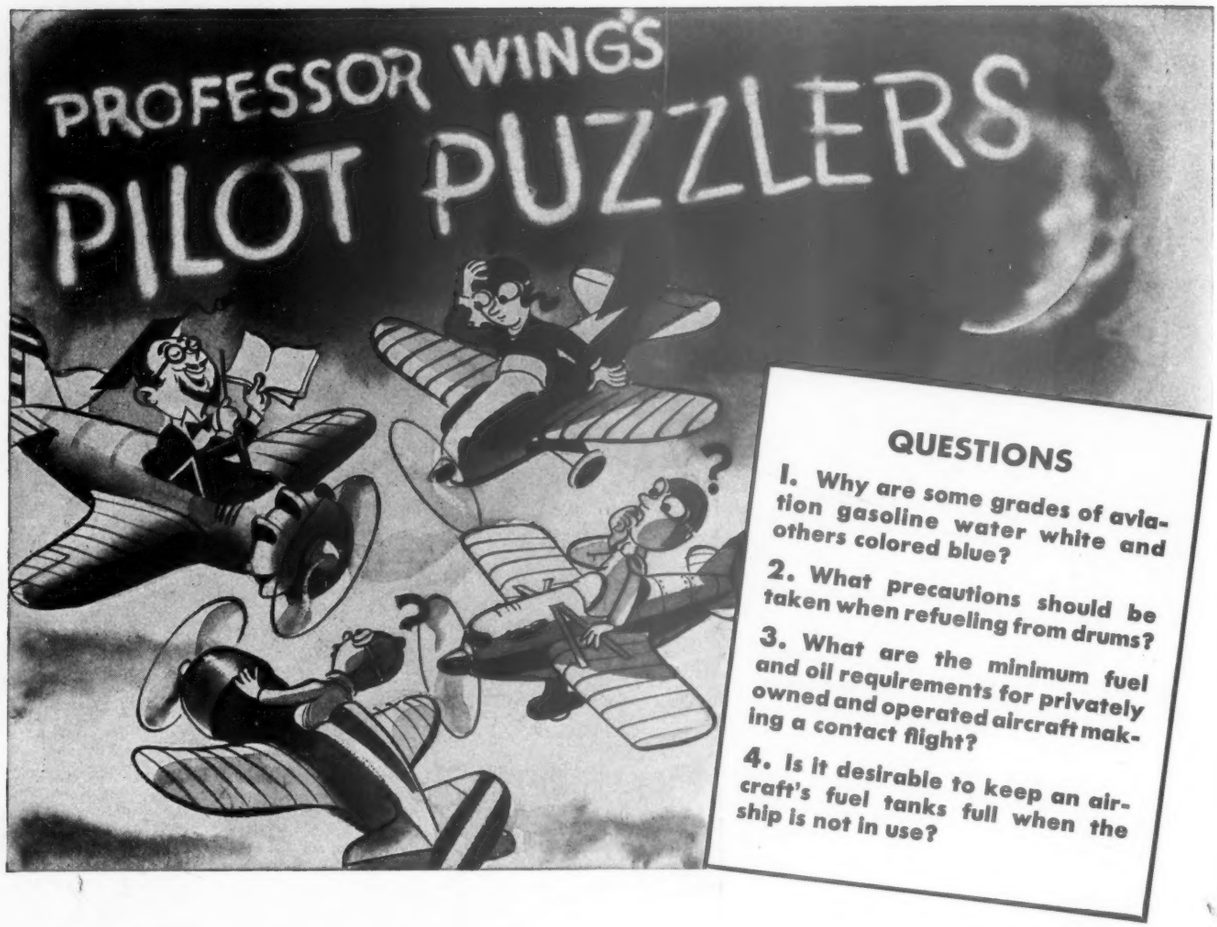
PROFESSOR WING'S
PILOT PUZZLERS
QUESTIONS
1. Why are some grades of aviation gasoline water white and others colored blue?
2. What precautions should be taken when refueling from drums?
3. What are the minimum fuel and oil requirements for privately owned and operated aircraft making a contact flight?
4. Is it desirable to keep an aircraft's fuel tanks full when the ship is not in use?

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ANSWERS

1 Only aviation fuels which do not contain tetraethyl lead are water white. A blue dye is added to aviation gasolines to indicate the presence of lead. No differentiation is made in shade of blue for various lead contents.

2 The suction stub of the pump should be several inches from the bottom of the drum. It is also desirable to remove fuel from drums only after the drums have been allowed to remain in position for some time so that any moisture breathed in has settled. When refueling from drums, it is advisable to run the fuel through a chamois or filter funnel.

3 According to the Civil Air Regulations, no aircraft shall take off without sufficient fuel and oil to arrive at its point of first intended landing and there effect a safe landing, taking into account wind and other conditions to be encountered during the course of the flight. Other special provisions apply to scheduled airlines.

4 Yes. To minimize the amount of moisture that is breathed into fuel tanks with changes in temperature, it is desirable to keep the fuel tanks full. Care should be exercised, however, not to fill tanks completely with cold fuel if the aircraft is to be stored in a warm hangar. If the temperature of aviation gasoline is raised from 60° F to 70° F, this 10° F rise will result in an increase in volume of approximately 7%; consequently, tanks that are completely filled with cold fuel will overflow when the fuel warms up.

SHELL
AVIATION PRODUCTS

For a quarter century, AVIATION Magazine has published the significant, up-to-the-minute information on aeronautical engineering subjects. The magazine has been one of the industry's chief clearing houses for both design and production problems. Our first issue appeared in 1916 under the title of Aviation and Aeronautical Engineering. Down through the years the dominating policy of publishing the latest and most authoritative material has persisted. In the past two years AVIATION has published a substantially increased amount of engineering articles in order to keep pace with the growing activity of the industry.

As an added convenience for our readers we are now indexing engineering and production articles together in the table of contents. A new department devoted to practical engineering short-cuts, called, "It Isn't in the book," will also be a regular feature. In these days when textbooks lag so far behind factory practices this should prove to be a valuable series. The popular Sketch Book will continue to be a monthly feature.

Aviation

ESTABLISHED 1916

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AVIATION IS INDEXED IN READERS GUIDE TO PERIODICAL LITERATURE AND IN INDUSTRIAL ARTS INDEX.

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DESTINY PAUSES

TO COUNT THEIR NUMBER

Even as the school boy knows that this war and future wars will be decided in the sky, military men know that the decision will go to the side having the dominant *defensive* air force. ▪ Whole cities may be prey to the bomber . . . but the bomber is prey to the pursuit plane—the airplane of defense. Given a sufficient number of defense planes and the trained men to fly them, and neither cities nor armies nor ships can be bombed into submission. ▪ So, with the fate of nations and the very existence of empires at stake, the issue even now is being resolved by the Squadrons of Pursuit. Their might challenges that of the mightiest dictator. Upon the courage and skill of their fighter pilots and the effectiveness of the planes they fly, rest the future hopes of hundreds of millions of people. ▪ Destiny pauses only to ask—is their number equal to their historic assignment in the present combat?

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A Tax Law at Last

» PASSAGE OF THE EXCESS PROFITS TAX LAW is really an anticlimax as far as the aviation industry is concerned. If the manufacturers had waited for it our air defense program would have been seriously impaired, so they went ahead accepting orders and expanding plants without thought of remuneration or profit. It takes a lot of courage for a fellow who has spent a good part of his life struggling to get by, to barge into his first big opportunity to cash in on his lifework without any idea of how he is going to make out. But this is the position in which many of our manufacturers find themselves. The future is full of the uncertainties of over-expansion and of prospects of government dabbling in private industry. And you can't blame the aircraft builders who have taken time out to buy little farms for social security insurance.

» ORDERS ARE COMING IN THICK AND FAST and you could attend a ground-breaking ceremony for a new plant somewhere almost any day. The broad outlines of the defense program have been laid down and now its execution is the immediate problem. The next big job is to determine the relationship of military and commercial aviation and that is an extremely delicate task. Someone will be faced with the heavy responsibility of getting more transportation out of our present airline setup as the present shortage of airline pilots becomes more acute. It may be necessary to eliminate some infrequently used airline services and even to curtail some long non-stop schedules to provide for transportation of more passengers and less gasoline. The airlines must face these facts squarely and study the possibilities of more intensive use of personnel and equipment before it becomes necessary for arbitrary governmental action.

» ANOTHER AIRLINE BUGABOO is the airport situation. It is inevitable that military aviation will make increasing demands on already cramped airport facilities and a national emergency might close some airports completely to airline use. There is understandable reluctance on the part of most operators to provide their own landing facilities but it may become necessary to do this at strategic points to insure unimpaired operation in the event of emergency.

» YOU'RE A PIKER down Washington way if you don't talk in billions. This applies to everything but airports. Congress has just squeezed out a reluctant $40,000,000 for the construction, improvement and repair of "not to exceed 250 airports." According to our best recollection 40 million dollars is the price for construction alone of one La Guardia or about three Gravelly Point airports. It appears that we will have to build very small airports or build bigger ones much more efficiently if we are to obtain and maintain 250 for $40,000,000. Obviously this is not enough money, but it is a fair beginning. It behooves the Administrator of Civil Aeronautics, who is charged with the selection of projects, to act quickly and wisely to convince Congress that this money has been well spent and that further appropriations are sorely needed.

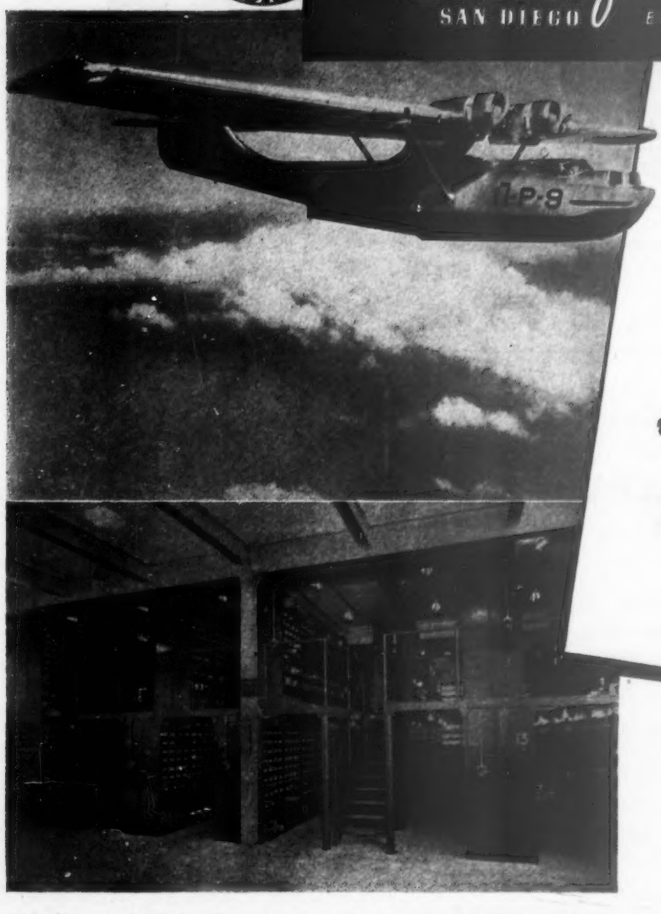
» WE GREW TIRED of writing about billions and sought refuge north of the border from numbers we couldn't understand. We found you could divide our defense program by ten and the result was a pretty accurate picture of the Canadian air rearmament program. For example, Canada has placed orders for 3,800 planes and they are now being produced at the rate of 100 per month. Most of these ships are trainers and the production rate may drop in numbers but increase in poundage as a higher proportion of combat planes are turned out. The program calls for substantial numbers of U.S. types, about one-third of the ships on order being North American "Harvards" and Fleet "Finches." British designs include the Hawker Hurricane, Handley-Page Hampden, Supermarine Stranrear, and Avro Anson.

» THERE ARE BOTTLENECKS APLENTY in the Canadian scene but the manufacturers are doing a good job of working around them. Engine deliveries are slow, but, as two manufacturers testified, they seem to come through somehow when needed. Accessories frequently hold up final assembly. But the program is going forward steadily and credit for a large share of its recent acceleration is due to dynamic Ralph P. Bell, whose job it is to see that it keeps moving.

CONSOLIDATED AIRCRAFT

CONSOLIDATED Aircraft CORPORATION

SAN DIEGO ESTABLISHED 1923



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» CANADA HAS LEARNED a lot about production from us. An outstanding example is the efficient and well-equipped Noorduyn plant at Longue Pointe, which is now increasing its output of Norseman radio trainers and tooling up for production of the North American Harvard. The jigs and special metal working tools installed, indicate that a careful study of the efficient methods of the U.S. plant has been made and some new ideas thrown in. An interesting experiment in plant dispersal is being tried in the production of the Handley-Page Hampden. Six different plants make subassemblies which are collected and put together at the two assembly plants of Canadian Associated Aircraft, Ltd.

» CANADA CAN TEACH us a lot about legislation and government regulation of industry. Their problems are similar to ours but they seem to solve them with much greater ease. One example is their excess profits tax law. Its story is complete in twelve short pages, while ours goes on and on and you must hire expensive legal talent to understand it. Their formula is simple,—a straight 75 percent tax on all profits beyond a four-year average, with individual treatment of new or unhealthy industries. Amortization of new defense facilities is extremely flexible,—a whole new plant may be absorbed in a single contract or it may spread over several years. How much and how fast is decided by the War Contracts Depreciation Board. And the Dominion Government makes no bones about building plants. They would rather stand the expansion costs than to saddle a manufacturer with a responsibility that would impair his future health.

» YOU MAY ARGUE that the present state of war in Canada makes this simplification possible but that is not altogether true. Years before the war we called attention to an outstanding example of abbreviated legislation in the form of Canada's civil air regulations. At that time they had a thin little pamphlet which told all a pilot should know about the law. We had a document almost as big as the family Bible and even harder to read. Fortunately this particular instance has been remedied since.

» SOUTH OF THE BORDER we stopped off to see Larry Bell press the button to start the Airacobra production line. It had been a long time since we saw the historic Elmwood plant and the transformation was amazing. There are very few plants in the country where you will find such good housekeeping and as clearly defined and efficient an assembly line. Although primary emphasis is placed on production, to fill the combined British and Air Corps orders for about 1,600 P-39s, research is by no means dead at Bell Aircraft. We can't tell all, but we know the XPs run up into the high fifties and involve many new and ingenious uses of shafting and unusual engine location ideas. (For the first and only authoritative technical description of the Airacobra see the article by Chief Engineer Robert Woods in AVIATION for March, 1940). On this visit we saw the site of the new Bell assembly plant adjacent to Niagara Falls airport and a brilliant exhibition flight of the P-39 by Test Pilot Stanley.

•

IT PAYS TO FLY

» IN NEXT MONTH'S ISSUE we are again planning too help, editorially the fine maintenance work being done by the industry. This is a continuation of AVIATION's yearly maintenance issues presenting problems of current importance and interest. For instance, maintenance problems vital to both the industry and national defense is that which is done by the military services. In December, therefore, along with commercial maintenance, there will be a description of the Air Corps and Navy facilities which will be of great assistance to those speeding our civilian and defense air programs.

In addition to this material there will be a summary of the West Coast meetings of the Society of Automotive Engineers. Gatherings such as these are becoming extremely important with the rapid pace of engineering developments, and, as a medium of interchanging the material presented at Los Angeles, the summary will include abstracts of many of the papers.

"Poor Maguire! He's figuring his profits under the Excess Profits Law."

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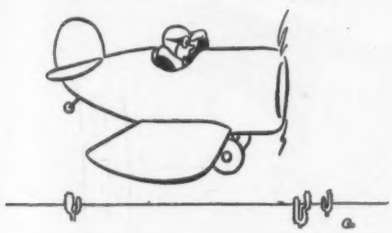
Side Slips

By Robert Osborn

» CAVU AT EL PASO: The El Paso Airport is set out in the desert like a lone freckle on the top of a bald headed man's cranium. On one of those rare



days of unlimited visibility and ceiling from border to border and coast to coast, an exhausted young pilot landed there and weakly whispered to the service manager, "God what a trip, I've been flying blind for two hours." "Impossible," replied the manager, "We've never had better weather." "I know," answered our hero, "But I lost the railroad track 200 miles back!"

» MISSING PERSON: I have always been glad of my early discovery that the percentage of gentlemen, and of interesting people, is as high among the working men of a factory as it is in any other field of work or profession. When the grease is scrubbed from his hands, the overalls replaced by "store" clothes, and his shoes are black calfskin instead of the thick-soled clods, you'll find the workman at the best of the plays and concerts, with his very attractive wife, and his intelligent and well-behaved children. I prefer him any time as a conversational partner to the so-called gentleman of leisure.

Having been exposed to a few years of Spanish at college, the translation of letters in that language to the company was often handed over to me. However, my Spanish was so sketchy and the translations so poor there was always the fear of being responsible for some international incident which would have to be straightened out by the State Department. I was particularly poor on the tenses, and in one letter from South America I could not tell if the writer was asking the company how to twist a propeller blade to change the pitch or was telling us that he had already twisted the blade and wished to know if that was all right. So, I went into the shops in search of a man who might know his Spanish more thoroughly.

The Machine Shop foreman said, "Try that fellow over on that lathe. He's new and might know a language or two."

"He is very dark," I commented, "What nationality is he?"

"Haven't the slightest idea," he said, "He just walked in and knew how to handle a machine so I gave him a job."

The workman wiped his hands carefully on some waste and took the letter. His eyes went down the lines so quickly he must have known his Spanish like a native. He looked up and smiled, "That entire paragraph just says that he received the last letter from the company and thanks you for it. You know how flowery the Spanish are in their salutations." Then he translated the rest of the letter so effectively and quickly it was easy to see he knew a lot about airplanes also. Further conversation brought out that he was a Hindu, had spent three years at an American university, was a graduate of a famous English university, and could speak English, French, Italian and Spanish as well as his native language. After the war, in which he had done a lot of flying as an observer, he had returned to India and, with his father, had started publication of a local newspaper. The authorities did not take kindly to the editorial policies therein, so they finally decided to suspend publication and search for other fields of endeavor. It was his intention to work in the American shops for a while to gain experience, after which he was going to a local field to learn to fly, then he was going to South America to establish himself as a representative of British and American aviation firms. Later I saw him at the field, where he had proven to be a skillful pilot with a lot of solo time.

Then he disappeared and I have always regretted letting such an interesting fellow get away without having his forwarding address noted down. I hope he has been successful in his South American enterprises, and if perchance he should read this, and recognize himself in this description, I should be very glad to hear from him.

» PERMANENT JOB. One day the factory superintendent asked me to help him devise a system so a man wouldn't have to stand next to a turbine power generator whenever it was running to be ready to pull out a pin which acted as a safety valve. He worked out a satisfactory device in about 20 minutes.

"Thanks very much," said the superintendent, "It certainly was a simple matter to fix it permanently, and I can save a big item of expense."

"Is this the only work this man has been doing?" I asked, "Just standing here waiting to pull this pin out if necessary?"

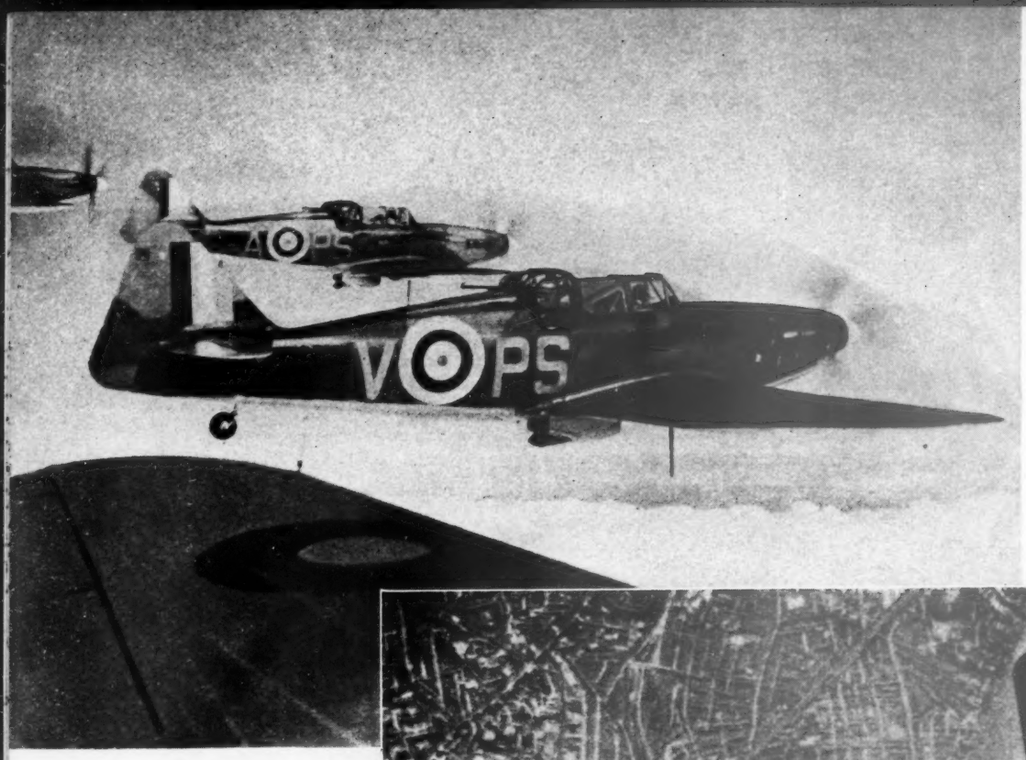
"Yes. He had to be here whenever the turbine was running."

"Has he ever had to pull the pin?"

"No."

"How long has he been at this job?"

He asked the workman a question, then turned back to me and said, "Seven years."



British Combine

Above: Boulton Paul Defiants going out in search of Nazi bombers.

Wide World

Some enemy bombers will always get through. A German bomber over the India Docks of London.

"Thumbs up!" says this English lad, after a Dornier 17 had crashed in a residential district.

International

BY SPECIAL CABLE TO AVIATION MAGAZINE
Kingston-On-Thames, October 15th.

THUMBS UP!

—is the "all well" symbol of the British these days.

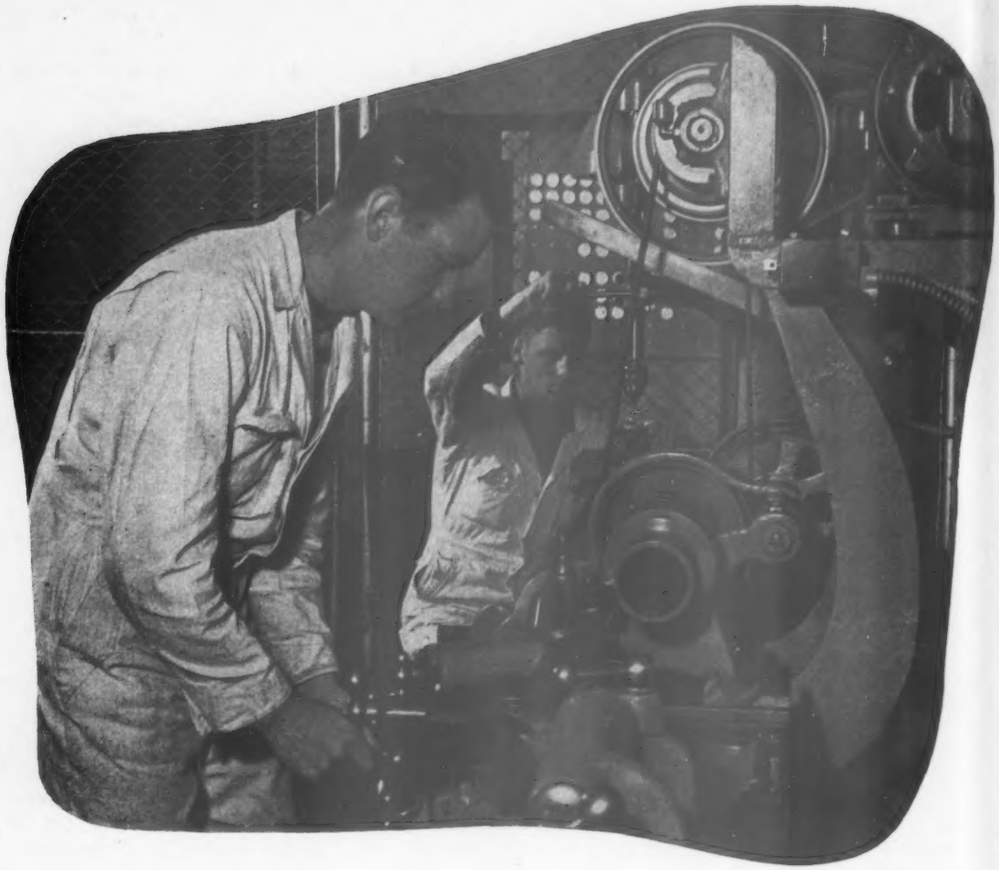
THE Marshal of The Royal Air Force, Sir John Salmond, when Chief of Airstaff after defense exercises five or six years ago, said that some of the enemy bombers will always get through. He is now using his high intelligence and great experience on the problem of stopping them. With him is associated Air Marshall Sir Philip Joubert Delaferte, whose broadcasts in England and the States have been among the most heartening and impressive of official utterances on the air war. Marshal of the R.A.F., the Viscount Trenchard, has all along preached bombing the other fellow to stop him from starting. That policy is also being actively pursued. The idea before the war was to develop sea interceptor fighters, but that was purely a defensive weapon and all here agree that defense is the first stage of defeat, as it was in France. Offense is the only reliable defense. Hit first and keep on hitting constantly.

In daylight and clear weather little harm is done to London or other important centers by Nazi bombs. Remember that London is not England, Scotland, Wales or North Ireland. When the Germans start in the early morning from France, Belgium, Holland, Germany, or even Denmark or Norway, they are met often far out at sea by our fighters and brought down in the proportion of anything between three and ten Germans to one of ours. And every German brought down is dead or a prisoner. Most of our pilots escape by parachute. When clouds are thick and low, enterprising Germans sometimes get through and bomb wildly and disappear, but they are followed by sound locators and the anti-aircraft guns, working with predictor machinery. The sound locators fire at the sound through the clouds and box the raiders in a barrage which always drives them away. Above the clouds they are beset by the fighters. On clear moonlight nights the sound locators track the sound of enemy engines. Their course is plotted by a special staff at the fighter command. Heavily-armed night fighters are warned by radio to go in that direction and hunt for them. Searchlights show them up. The rest is easy. On thick nights things are not so good. Searchlights are useless and fighters cannot find the enemy without help from the ground, so the guns fire by sound through the clouds. But if the clouds are low, star shells and tracers show the whereabouts of the enemy to the fighters above, and they go looksee, often with good results. Without being over-optimistic I do believe that there are new weapons being developed which will enable the R.A.F. to sink the enemy in the dark as well as in daylight. So far they are only being tried out experimentally. The Germans are trying all sorts of bombs, both big and little, high explosives, delay action, or time bombs, land mines, incendiaries, and a good proportion of duds that don't go off.

The real heroes of defense are the chaps who dig up the time bombs and hurry them to wide open spaces. The other heroes are the amateur firemen, the ambulance folk, the gunners, searchlighters, and sound locators. Even the night-flying pilots have cushy jobs by comparison. But they all admire one another so they are all happy. London still carries on and is not noticeably altered in shape. If it were all destroyed England would still carry on. Sirens, however, are a nuisance.

The roof-spotter system on factories and offices works directly with the listening posts and depends on individual judgment. The results have been excellent in keeping up man-hours and the production of munitions, and in preserving life.

C. G. GREY



Employment managers give preference to men with aviation training. These youngsters are learning machine shop work at the school of California Flyers.

How Aircraft Factories Find Their Men

Airplane plants on the West Coast have increased their manpower from 15,000 to 45,000 within a year. Thousands more will be hired. This is where they come from.*

NOW nibbling away at a backlog of more than a billion dollars, the Southern California aircraft industry is already "over the hump" in its personnel procurement program. This in the face of new factory expansions, such as the $20,000,000 building program now under way by Douglas! We don't mean to say that the personnel managers can coast from here on in. But it is interesting to point out that from a total of 15,000 workers in 1939, payrolls have been upped to more than 45,000 in 1940. And the expansion now under way does not seem to require more than a total of 100,000 aircraft workers in this area by the end of 1941. The formula for employee training has been well established and it should be possible to follow it successfully in meeting any future need of our national defense program.

The story of how this army of 30,000 factory workers has been put to work in approximately the space of one year is a bit involved, but some indication of how it was done, and of how future needs will be met, is given by quoting the enrollment figures of almost 2,000 students at a single private aircraft school in this area, Curtiss-Wright Technical Institute, Glendale. Also, the public high schools and junior colleges of Southern California, with the help of the federal government, have more than 9,000 students under instruction in various aircraft courses.

Aircraft personnel men are working closely with both private and public schools. Generally speaking the private schools provide the thoroughly trained workers who quickly become lead men and supervisors. The public schools train thousands of men in short job training courses which fit them for jobs

*This is the second article of a series on factory training methods, the first of which appeared in the October issue.

as riveters or sheet metal workers. They also train an appreciable number of aircraft mechanics. At the same time there are many private schools giving job courses. As a matter of fact, there are more than 50 private aircraft schools in California. They range all the way from imposing institutions covering many thousands of square feet of floor space in modern fire-proof buildings, down to the school which is currently doing a good job of training hundreds of riveters in the chicken houses of an abandoned chicken ranch in the San Fernando Valley.

It is doubtless a good thing for the industry, and for the private schools, that the temporary load of job training can be carried by the public school system. The private schools are the very heart of the whole training system, as they provide the close relation with the industry and the concentration on specialized courses which will always be needed for training serious recruits to the aircraft manufacturing industry. The real value of the private schools is found in their long courses of ten months or more of concentrated study on aircraft production subjects. By giving the bulk of job training work to the public schools the better private schools are kept more nearly free to concentrate on their long courses. Also, this public school activity tends to discourage the mushroom private job training schools which, except in certain specialized cases, are not helpful to the factories or to the better private schools.

Factory personnel men prefer to hire the graduates of long-term courses such as are given by the better private schools, and if such men were always available they would never hire the job-trained men. However, the private and public schools together cannot supply the current demand for thoroughly trained men and it has been necessary to compromise. This compromise consists of taking men who are trained to do just one thing and do it well. Usually these men are trained for rivet work. A large portion of such training is being given by the public schools although, to meet urgent needs, at least one manufacturer has contracted with private schools to train large numbers of riveters at the manufacturer's expense. In any case these riveters are encouraged to continue their training during leisure hours after they have been put to work. Between such extension training, on-the-job instruction and encouragement by lead men and supervisors, these "green" workers are moved ahead as fast as possible, making room for more riveters at the bottom of the personnel ladder.

By Charles F. McReynolds
Pacific Coast Editor, Aviation

Factory personnel men have worked very closely with both public and private schools in helping to set up courses, in supplying experienced teachers from among qualified factory men, and in encouraging enrollment in such courses on the part of factory employees. Frequently the night school instructors are men who are working a full shift in the factory. In many cases school instructors are released by the manufacturer with a guarantee of their jobs back with full seniority rights when the emergency training program is over.

Since the employee training program has been largely turned over to the schools, public and private, instead of being administered by the manufacturers direct within their own plants, we will briefly outline the school situation on the Pacific Coast. Certain California public schools have been outstanding in their development of aviation courses. Such schools as the California Polytechnic Institute at San Louis Obispo, George Washington High School and Frank Wiggins Trade School, Los Angeles; Sacramento Junior College, Pasadena Junior College, and a number of others have shown great initiative in providing aviation training. Frank Wiggins Trade School, for example, a Los Angeles city school, has more than 250 students studying courses in aircraft drafting, welding, sheet metal, machine shop, and engineering. Such courses have now been set up in almost all Southern California high schools and junior colleges as a result of the National Defense Program for vocational education, initiated by the U.S. Office of Education. Such training is being financed during the current quarter out of an appropriation of $15,000,000 covering all national defense education, al-

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Every factory is giving advanced training to its men. C. T. Reid, Douglas educational director, is shown instructing plant employees.

Looking up the production line when the French Bombers were being built. Notice separate nose, center, and tail sections each built as an individual unit

BOMBERS IN QUANTITY

When engineers in competing organizations say, "They do a fine production job."—that's news. The Martin engineering staff is praised throughout the industry for it's efficient work.

By Jay P. AuWerter, *Assistant Editor*

THREE bombers a day is some production rate—but not to the Glenn L. Martin Co. They were doing this and even more at the time when production on the famous French Martin Bomber was in full swing.

To stand at the end of the assembly line and watch the finished ships roll off, the tremendous amount of planning and experience necessary for such a record is not readily noticed. It has come about only through a vast amount of training and personnel cooperation all striving for a goal that is the aim of every aircraft plant.

The successful production of an airplane depends on certain fundamental factors. The ship must be well designed not only for optimum performance but also for ease of production.

The first two of these points is left to the design engineers, while the carrying out of the second becomes the job of the various production departments. Their task is obviously a big one and when done well the company shows a profit; if it is not done well, the figures are in red.

In order for production to flow most effectively through the plant there must be perfect coordination among the production departments, with advice from engineers on certain phases of design. To accomplish this at the Martin plant, a planned series of meetings is held throughout the whole period of production of a model and in these all irregularities are ironed out.

Intensive engineering on a new model begins on the day the contract has been agreed upon between the customer and the company. As soon as agreement on the type of ship, its price and other features has been reached production planning and scheduling is started. The contract date for delivery is always the deadline for production and the scheduling of the ships for construction is made backwards from this day. Every step in the process must finish on time.

Final Engineering Design

When the final design of the airplane has been agreed upon a schedule is set up for the engineering department to follow in releasing blueprints of the various plane parts for production. As designs are ready to be released a meeting is called between the planning, tool design and engineering departments. At this conference the design is thoroughly investigated and a final agreement reached on any changes necessary for ease of production. To speed or facilitate production the engineering department then releases copies of the design to both the production planning department and the tool design department simultaneously.

Scheduling for Production

One of the most important steps in the production program is the determination of what parts are to be subcontracted. In periods of rapid expansion

subcontracting is more important than ever. This is done at an early meeting of Harry Vollmar, vice president in charge of manufacturing, with the production engineer and factory manager. First a decision is made on subcontracting the important main assemblies, then on the subassemblies, and last on the small parts; this decision is based on the available equipment in the plant and the production load that it is to carry. When this meeting has been concluded all of the necessary preliminary preparations have been completed and work can begin on the model.

Previously the engineering department has sent advance information to the materials section of the planning department as to the materials needed to produce the plane. They in turn check the material available in the plant and decide what has to be secured from outside sources, requisitions are sent to the purchasing department. This department is responsible for placing orders for the material and for insuring that deliveries are made on the days designated in the production schedule.

At the same time these other preparations are made, the production planning department has been working with the estimating group in outlining a schedule for the flow of the work through the plant. Their knowledge of the facilities and men enables them to outline accurately the length of time for each operation. If time alloted calls for a tight schedule, and it usually does, just what departments can and need to be speeded up is known by them almost immediately. They also know what new machines are to be bought, when the floor space is too small and what changes in the shop layout must be made so that the most efficient production line for the new ship will be the result. In short they are responsible for the most profitable, the most practical and at the same time the most rapid production line.

The Tool Design Department

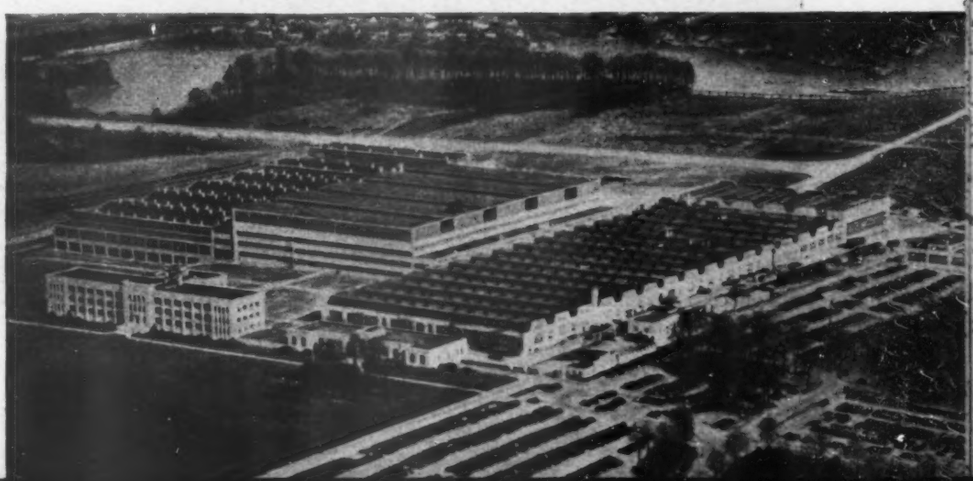
One of the most important units of the production deparments, and one that the Glenn Martin Co. can well be proud of, is the tool design department. This is one of the largest of its kind in any of the airplane plants and as a result the Martin plant uses its specially designed tools for many jobs.

The department keeps in constant contact with the designers on plans for new models; in this way the preliminary work is based on consideration of possible production methods. The tool design engineers, however, are charged with the duty of making the tools as economically as possible to insure a minimum of cost on the order. To do this, they have a rule of thumb which governs their work: A tool when made for a special job, must pay for itself during the length of the job upon which it is going to be used. This, of course,

One of the final steps is the "run-in" for checking controls and engines

In the machine shop are built many small parts and tools

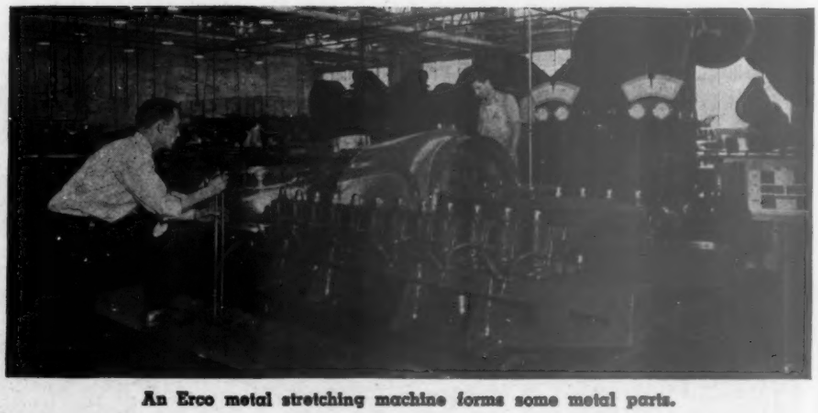
The present plant, left to right buildings C, B and A



A typical drafting room where preliminary designs are made.

Raw material upon arrival is placed in the raw stores department.

Zinc and lead dies are used in stamping out difficult shapes.



An Erco metal stretching machine forms some metal parts.

applies to tools that are designed to eliminate other means of fabrication, as there are numerous instances where a piece of work cannot possibly be fabricated without the use of a special tool, and in this case the tool must be made at any price.

If a certain piece to be fabricated requires the use of several tools or jigs, then this department must figure out just how many special tools and jigs must be made so that the total cost of the tools, the worker's time and the material used will be a minimum. In many cases the man-labor-hours saved will pay for the cost of the tooling, and when this will be the result the tool is made.

This tool design department contributes much in addition to the actual dollars and cents saved on material in fabrication. For instance, an efficient tool very often requires a man with less training to operate it than is required by the operation which the tool performs. In this way the training cost for instructing the personnel is reduced and in times such as these when skilled labor is at such a premium this situation is highly desirable.

The newly designed tools are constructed in a special tool room which covers a large section in the original Martin building. Here are located all of the precision machines necessary for producing almost any tool or jig and here a crew of highly skilled machinists is at work.

After the meeting of the production heads of the plant following the released design of the new ship, the tool design department takes over the production plans and decides what tools, dies and fixtures will be necessary for efficient production. The designs are made by the tool design engineers and turned over to the tool room. Here they are constructed according to a predetermined schedule. When once completed the finished tools or jigs are placed in the storeroom and are removed from there by the production planning department who place them in the correct place out on the plant when building up the production line.

So far none of the actual construction on the new design has been done. That is, not any of the fabricated parts have started through their production lines in the plant. The design has been decided upon, the materials have been bought, the production line has been set up and all the necessary machines and tools have been put in place. When all of this has been done, everything is set to start the material flowing through the plant. But before describing the actual production line it would be well to look into the photographic process which the Glenn L. Martin Co. has developed to smooth out its production system.

Photographic Process

The photographic process is one that, through the use of an heroic-scale camera, photographs directly on nearly every kind of surface whether it be wood, metal, cloth, or paper, engineering drawings that are used in the production of the new plane. The camera takes pictures of the desired drawing and the negatives are developed and the images projected back to large sheets of aluminum alloy metal (or any one of the other materials) whose surfaces have been sensitized with a special emulsion. Then when the sheet has been developed the drawing appears, to any scale desired, directly on the surface of the metal. In this manner, in a very short time any number of drawings can be reproduced which previously might have required a considerable length of time in redrafting. Incidentally, last year the company saved more than $80,000 in drafting alone through the use of this unique process. Through it engineering work has been speeded tremendously. Tool designing and tool making have been carried out more rapidly and more accurately. Production preparations have been gotten under way quicker and any necessary changes have been made in a minimum of time.

However, this process has many other uses in the plant. For instance, when an experimental airplane is to be built, perhaps a model for the wind tunnel, the full size engineering drawings for the ship can be scaled down by the camera instantly to any desired size, or when the full size plane is to be made, the master drawing can be photographed directly on to the metal of which the ship is to be constructed and many parts cut directly from the material itself.

During this process duplicates of each drawing are made. These duplicates go to the various departments. For instance, tool design gets at least one; production perhaps two or three more; engineering several copies, and any other department which requires copies of the drawing. When dies or jigs are to be made from the duplicates obtained in this process, little holes are drilled along each part for which the tool or die must be made. Under the layout is a piece of sheet iron and when the photo drawing is lifted, the contours are marked clearly by the drills. The parts formed, or templates, then are cut out of the sheet metal and sent to the shop to be used in manufacturing.

Central Planning Department

The central planning department takes care of all of the actual flow of material through the plant. It has vari-

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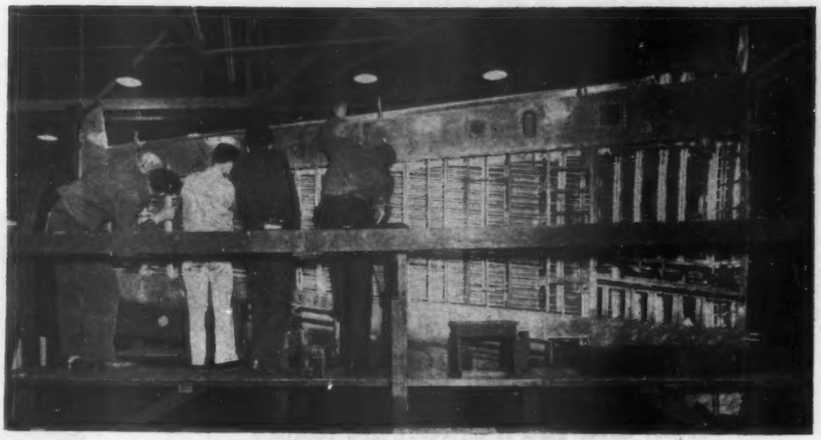
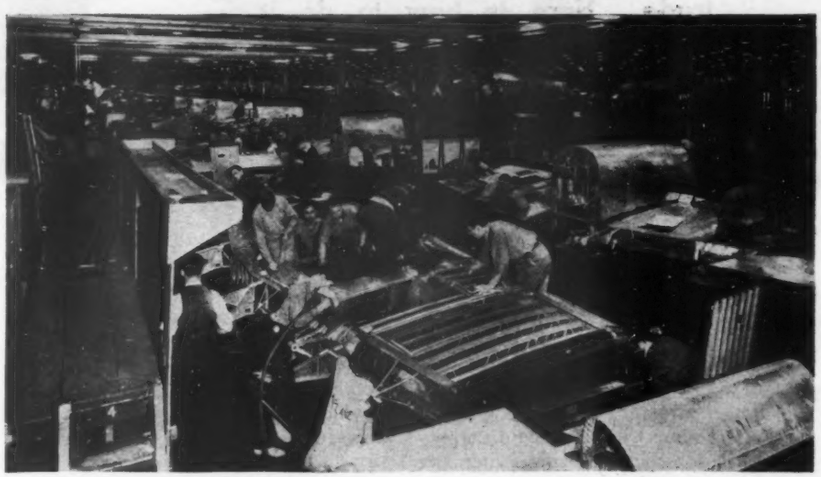


Wings are built in vertical jigs for easy accessibility.



Center sections are made as one unit in horizontal jigs.

Nose sections are built in halves, then joined as shown.

More Fun at the Airport

Turn your airport into a country club, and you'll attract the luxury trade. Here is how to do it.

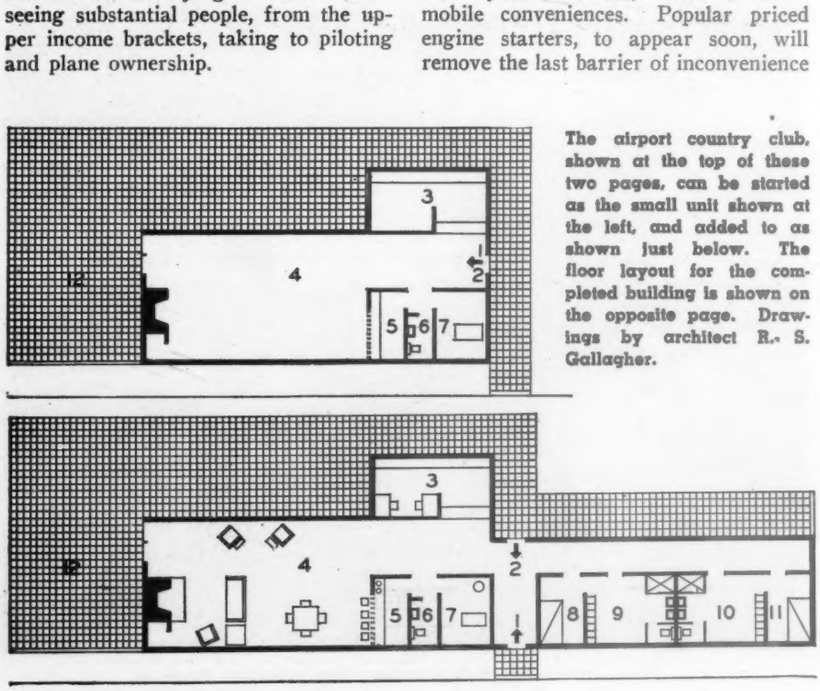
By William D. Strohmeier

AVIATION has passed the glamorous, helmet-and-goggle stage which throttled it for so long and which prevented it from becoming an every-day part of the average man and woman's life. Open airplanes on the new plane market are almost nil, and the disagreeable phases associated with flying are gone forever. In many respects we have brought flying to the same level as automobiling and a new type of person has become interested in the sport and convenience of flying. We are now seeing substantial people, from the upper income brackets, taking to piloting and plane ownership.

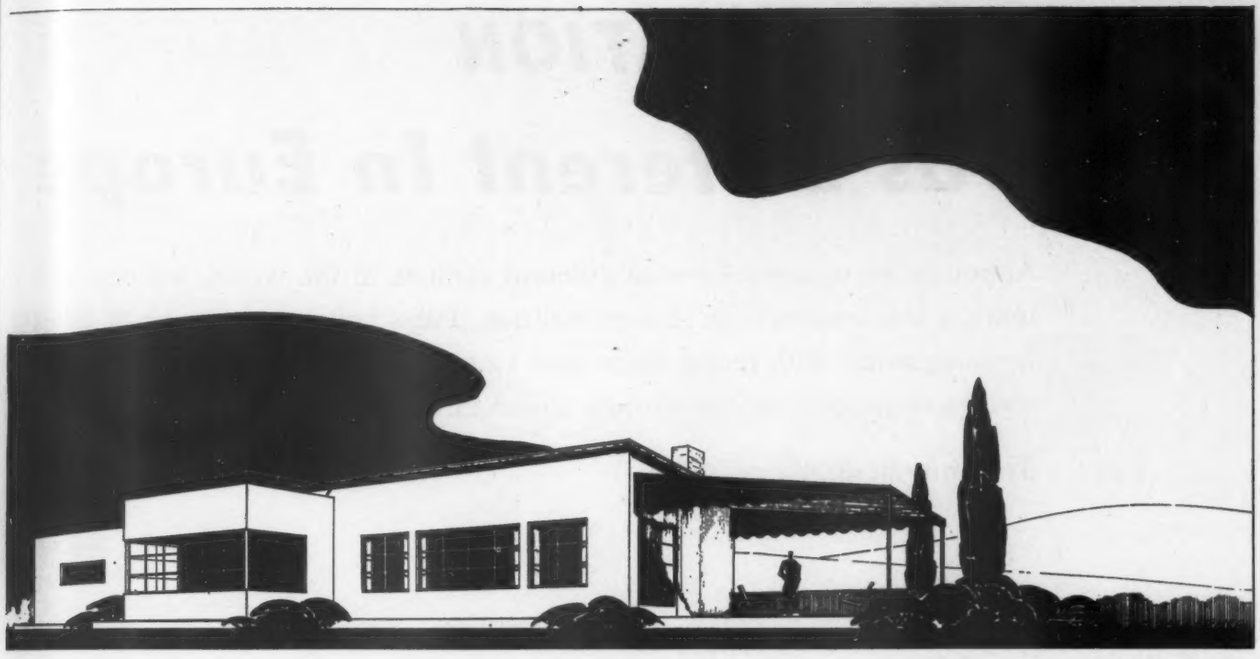
To many of these persons yachting has always been a symbol of sport and relaxation. They have been accustomed to the kind of expenses which a boat, even more than an airplane, entails. The rapid development and improvement of aircraft, plus lowered costs and improved performance, have done much to accomplish this long-needed change. The light ships, which predominate, are showing sensible and well thought out designing in the form of mufflers, "Detroit-styled" interiors, and other automobile conveniences. Popular priced engine starters, to appear soon, will remove the last barrier of inconvenience to the aircraft purchaser, particularly the older individual whose support of aviation can be most important.

While reflecting on this credit side of aviation development, however, we must not ignore the fact that another phase of aviation, equally as important as airplanes themselves, has not quite kept pace. Reference, of course, is to the airport. While pretty little "fix-in's" and neat appearance of modern airplanes have done much to bring the substantial citizenry to flying, the major part of our airports have not undergone such face lifting. By and large they still are the familiar hay lot, hangar, and leanto. Most of us in aviation have become quite accustomed to the quaint shabbiness and lack of facilities of the present airport. To many of us, the dust of whirring propellers, the broken-down bench by the hangar door, the combination office and repair shop are traditions which are as much a part of aviation as OX's and Jennies.

We must realize, however, that the outsider sees aviation differently. When C. D. Godfrey Hefferdust, who has or had a $5,000 yacht down in the harbor, gets an inkling he might like to fly one of these days, his initial drive out to Smith Fying Service is a bit on the negative side. Mr. Hefferdust for one thing, probably can't find any one who can tell him about owning an airplane, (or who has the inclination to) but above all, the same Mr. Hefferdust takes a look at what might be his future hangout and rushes back to the Country Club or Yacht Club for two



The airport country club, shown at the top of these two pages, can be started as the small unit shown at the left, and added to as shown just below. The floor layout for the completed building is shown on the opposite page. Drawings by architect R. S. Gallagher.



double scotch-and-sodas, congratulating himself that he had gone no farther with his flying. The airport which is aviation's greatest ambassador, had failed to make a sak.

We have long ballyhooed flying as a sport, in fact the greatest sport of all, outrivaling golfing, hunting, boating and skiing. Yet when we compare our sport with the others we see immediately that something is lacking,—the sociability of flying. We speak often of the fraternity of flying, the closeness of those who have conquered the upper air, but that's not enough. For those who play golf, there are beautiful country clubs. For those who have boats, there are attractive yacht clubs. These facilities help combine the natural pleasures of golfing and yachting with the social contacts before and after the experience on the links or on the bounding main. Too often in flying it's a question of taking a half-hour flying time, paying out the four bucks, and then beating it home, to the movies, or the nearest bar.

To get down to brass tacks, the average airport operator is missing a great bet by not investing a little of his, or some one else's, money in socializing his airport, making it a place for John Doe and his wife to come for the afternoon or evening. Several airports have shown signs of removing the dusty traditions of the past and have gone "sissy." The well known and almost too oft used example of the Aviation Country Club at Hicksville, Long Island, is Exhibit A of a new atmosphere injected into flying for Mr. and Mrs. C. D. Godfrey Hefferdust.

Two other examples are particularly appropriate at this point however, and they are both on Cape Cod. At Falmouth and Hyannis, two very attractive club houses have been built in the past few years which have done worlds of good in stimulating a new and healthier interest in flying among those who can afford it. While both of these buildings have a noncommercial atmosphere, they are very definite assets to their sponsors, the local airport operators. At a number of other airports improvements have been made to appeal to the senses of customers who are getting tired of watching the airplanes fly, either from their car windows or the top of a gasoline drum.

AVIATION magazine in this article is launching a campaign and plea to airport operators throughout the country to look into some business possibilities which otherwise might be lost both from the standpoint of direct revenue and indirect good will. Herewith we present some thoughts, facts and figures on an airport country club building with the thought that they might suggest such activity to wide awake commercial operators. The remainder of this article deals with a practical type of airport building which can accommodate nearly all the needs of the average small-city airport. Before entering into the discussion, however, it must be remembered that these are intended to apply almost entirely to the privately-owned field. Since many municipal airports are narrow minded on any developments which might favor private flying, consideration of country club buildings for

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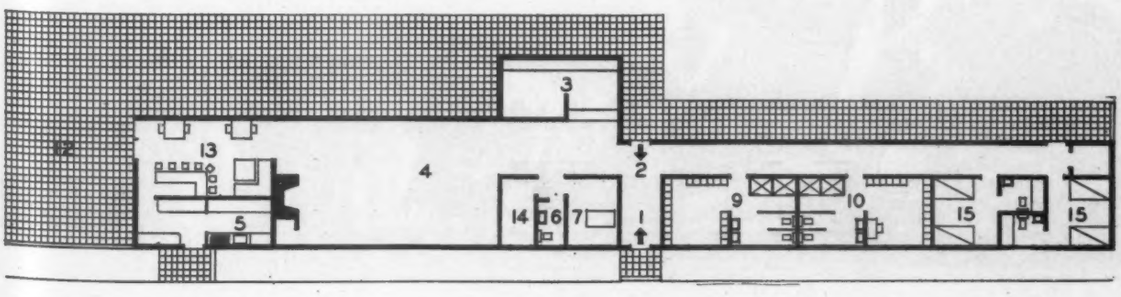


AIRLINE NAVIGATION
Was Different In Europe

Although we operate the most efficient airlines in the world, we can still learn a few lessons from foreign airlines. Pilots believe our weakest point is navigation. With larger ships and instrument landings soon due, it is well to consider how the world's oldest airline does its navigating.

By Lewis M. Gravis

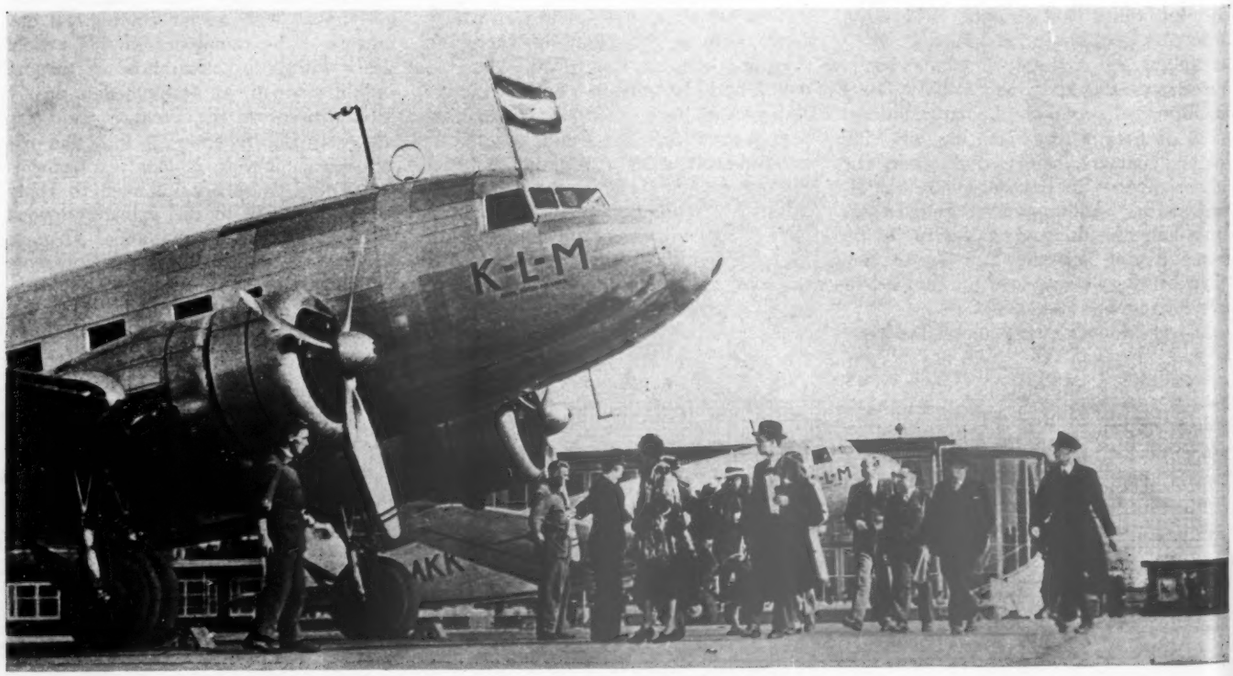
Lewis M. Gravis, an army pilot who flew with United, then with KLM in Europe until last summer, and who is now flying for Eastern Air Lines, has had a wide piloting experience.

IN the air transportation business the main idea is to get an airplane and its cargo from one place to another with safety, on schedule. At the very start of scheduled flying a pilot arrived at his destination only if contact flight was possible over his entire route. Then came the blind flying instruments which enabled him to fly the plane even though he couldn't see the ground. This was fine, but then the problem arose of how to find the place where he was going, and how to land in poor weather when he got there.

In those early days our planes were slow and their range was not great. It was not possible for them to leave a direct course to the destination and still have enough fuel to get there. With this situation in mind the radio range beacon was invented. At first we thought our troubles were over, but with the advent of higher speed equipment and greater experience in bad weather flying we found our troubles were just starting. The radio range had a lot of tricks, night effect, false cones of silence, and multiple courses, just to mention a few. Worst of all we found there was such a thing as rain, snow, and ice crystal static which prevented us from hearing the range at all.

Much time and money has been spent in an effort to eliminate these faults and some success has been attained.

KLM was organized in 1919 and has been flying continuously since then. The navigation methods it has worked out are of interest to Americans.



A KLM Douglas DC-3.

However, the radio range is still far from satisfactory. It is not reliable in keeping a pilot on his course at all times, and it is not satisfactory for landing with low ceiling and poor visibility. First the pilot is limited in his direction of approach to the station. He must come in on one of the legs of the range, and if he is off one of these he has no way of knowing how far off he is. When he gets to the radio range station he has one and only one fix. From that time on he must find the field by dead reckoning.

All this is nothing new to people in air transportation. It is borne out by the fact that the CAB has found it necessary to prohibit landings when weather is below a certain minimum. These minimums are not set on that visibility and ceiling that a pilot needs to actually land the plane, but on that ceiling and visibility that he needs to find the field.

An alltime safety record has been made, but this was only possible because of excellent dispatching systems, the best airline pilots in the world, and the fact that both recognized the failings of our navigation system and placed weather restrictions on flights. However, many trips were cancelled and an airline can't make money with its planes in the hangar.

It will be of interest to many to see how this navigation problem has been solved in Europe; in my opinion in a much better and safer way. The most advanced airline in Europe at the start of the war was KLM (Royal Dutch Airlines). This company used American planes for all its operations in Europe and on the Amsterdam-Batavia, Java line which was the longest airline in the world.

The crew on KLM's planes consisted of the captain, co-pilot or mechanic, radio operator and steward (ess). On the Amsterdam-Batavia run there were the captain, co-pilot, mechanic, radio operator and steward. The choice of the radio operator as the third member of the crew is wise. It permits the use of code instead of voice which is more satisfactory in heavy static conditions. It relieves the captain of a great deal ot work, permitting him to devote his entire effort to the direction of the flight.

The radio equipment in KLM planes consisted of a receiver unit capable of covering the entire frequency range from very short wave to the longest wave length used in Europe on any station; a 200-watt transmitter capable of transmitting on several different wave lengths; the short wave landing beacon receiver and direction finder. The direction finder was so built that it could be used as a radio compass and the pilot could tune in to a station and fly to it by visual or aural indication, or both. When using the compass aurally the pilot did not hear the incoming signal, but a long dash if the plane were headed toward the station, and dots if it were headed to one side and dashes if the other—much the same as our radio range beacons sound over here.

The capabilities of this radio installation can be judged by the fact that when a plane left Amsterdam for Batavia, Batavia was notified immediately after take-off from Amsterdam of the departure time, mail and passenger load, etc.; while circling the field at Batavia, Amsterdam was likewise notified. Enroute between these two

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TO SUE OR

Airport owners have been sued on many occasions for to keep planes grounded. But an airport owner has

By Solomon Rothfeld
Member of the New York Bar

THE problem of airport size and location may soon become a major obstacle and detriment to the fullest development of commercial aviation in the United States. There is already a shortage of usable commercial fields and this shortage will become more acute as all phases of private and military aviation expand in the near future.

A number of legal difficulties face airport owners, whether private or municipal, not only in locating new fields but in the actual retention of fields already in use. The most ideally located airfield may be rendered useless if the field's approaches are not clear, or if obstructions are built that make landing and taking off a hazardous task.

As property adjacent to airports is built up, apartment houses, towers, smoke stacks and other obstructions may put an end to flying. In numerous instances spite fences of one sort or another have been erected. The problem could be solved by building the airport so large that no type of obstruction at the edge of the field would hinder flying. But land is too valuable to solve the problem in this way.

Another remedy is the legal right of eminent domain. But condemning property may serve only for municipal or federal airports. Zoning ordinances have been attempted, but they have been declared unconstitutional in several courts.

Where the airport owner's solution lies is difficult to determine. It is the purpose of this article to find such a solution by studying the cases already decided in the courts. They may shed some light on the ultimate answer. With this in mind, we now turn to the cases bearing on this problem.

In the town of Grafton, Mass., around 1928 there was, and may still be, a beautiful estate known as "Lordvale," covering about 270 acres. There were fine lawns and gardens; although a good part of the estate was covered with dense brush. And the "Lord" of this manor was one Harry Worcester Smith, who became angry because directly adjoining his property an airport had been built by the New England Aircraft Co. This airport covered about 92 acres and its construction cost was about $100,000. Mr. Smith's main house was about 3,000 ft. from the airport and his contention was that the airport constituted a nuisance, what with the noise, low flying, and dust caused by the aircraft using the field, and further claimed that any flight across his land was a trespass and for that reason should be stopped by the court. And so Mr. Smith sued.

But despite Mr. Smith's indignation, the court refused to treat the problem too drastically. In the first place the court quickly dismissed the contention that the airport was a nuisance in the legal sense of the word. The court then said, "an owner's rights are limited to the airspace which is now used or may in the future be used in the development of the underlying land." The court held that the upper airspace was in the jurisdiction of the state and that flight over 500 ft. above Mr. Smith's property was not a trespass. However, there was some evidence in the case that in taking off and landing, planes flew as low as 100 ft. As to that, the court ruled that flight at 100 ft. was a trespass but the court refused to stop, by means of an injunction, flight at 100 ft. because the land traversed at that point was thickly wooded and had dense brush on it.

Thus, all in all, Mr. Smith's resort to the courts of Massachusetts was to no avail. The court specifically refused to rule that an airport in itself constituted a nuisance and held that flight at 500 ft. or over constituted flight in the upper airspace, which upper airspace is under state jurisdiction. The court did rule that flight at 100 ft. was a trespass but refused to stop such flight since it did not constitute a nuisance to Mr. Smith. The court said nothing about flying between 100 and 500 ft., that being significantly left open.

Now, let us suppose that as a result of this litigation Mr. Smith became even more indignant than when he first instituted this litigation and decided to put a stop once and for all to this flying over his property. And let us suppose that after weeks of thought he finally decides to build a 300-ft. silo on his property at a spot directly adjoining the airport and in a location directly in the path of the prevailing wind. With such an obstruction directly in the path of the prevailing wind, taking off and landing at the airport would cease at once. This would probably satisfy Mr. Smith, but the crucial question is whether the New England Aircraft Co. could do anything about it. Could the company force Mr. Smith to remove that obstruction? And, if so, on what theory or line of reasoning could this be accomplished?

A review of the cases decided after the Smith vs. New England Aircraft Co. case may answer this question and also our original general problem.

In 1931 Frederick L. Swetland and others sued the Curtiss Airport Corp., Ohio Air Terminal, Inc., and Curtiss Flying Service, for the purpose of preventing the Curtis Airport Corp. and the other defendants from completing an airport at Richmond Heights, Ohio, directly across the road from the Swetland property. The Swetlands claimed that they built their $115,000 residence prior to 1929 and that in May of 1929 the defendants bought 272 acres of land for $398,048 opposite the Swetland property and planned to erect an airport. The Swetlands claimed that the airport would be a nuisance because its operation would create huge clouds of dust which would drift onto the Swetland property, that there would be flying below 500 ft. during take-offs and landings, that circulars would be dropped from the air, that crowds would collect and overrun the Swetland property, that the lighting system at the field would constitute a nuisance and that all in all the value of the Swetland property would greatly decrease in value with an airport for a neighbor. It is true that in this case the Swetland residence was about 250 ft. from the airport, and flying below 500 ft. had to be expected. It is also true that the

NOT TO SUE

maintaining a nuisance. Neighbors build obstructions legal rights of his own, as this article indicates.

Swetlands were fast on the take-off for when they instituted litigation, the airfield was far from complete. And it was probably for this last reason that the Swetlands came out of the affair a little more successfully than Harry Worcester Smith of "Lordvale."

The court ruled that an airport was not in itself to be considered a nuisance but if improperly operated could become a nuisance. The court said that a property owner's effective possession to the upper airspace was 500 ft. and that flying over a property owner's land at less than 500 ft. although it may not be a trespass was, however, a nuisance and must be stopped. In other words, regardless of whether a plane is landing or taking off, by no means were the Swetlands to be annoyed by flying over their property at a lower altitude than 500 ft. The court also granted an injunction against any dust blowing over to the Swetland property or the dropping of circulars over the Swetland property.

But as to flight over 500 ft., as to noise caused by planes while warming up and in taking off, the attraction of crowds, and the operation of the lighting system, the court refused an injunction and refused to consider it a nuisance. The final result of this piece of litigation was that the Curtiss Airport Corp. was required to scrap its original construction plans and replan the airport so that the court's decision could, as practically as possible, be obeyed.

Now as for Mr. Harry Worcester Smith, it seems that under this decision, with the courts ruling that an owner's effective possession of the airspace is 500 ft. above his property, his 300-ft. silo could stand unmolested. But "Time Marches On" and our next scene of operation shifts to Atlanta, Ga., in the year 1934.

The City of Atlanta built a splendid airport. All went well until one day a Mr. Thrasher, who owned property adjoining this airport, began to take another view as to the necessity of having an airport for Atlanta. His complaint was that Mrs. Thrasher became ill as a result of dust blowing over to the Thrasher property caused by the use of the airport, that there was "terrific" noise from planes warming up, that flight over the Thrasher property constituted an imminent danger to the Thrasher peace of mind, and lastly that there was flight over the Thrasher residence at less than 500 ft., that all in all the airport was nothing more than a common nuisance and ought to be put out of business once and for all. But, fortunately, the court took another view.

The court did prevent the blowing of dust to the Thrasher property and ruled that Mrs. Thrasher could recover for her illness caused by such dust. But, as to the general operation of the airport, the court refused to do anything and reached this decision by a new theory, interesting in itself and of some possible use for our solution.

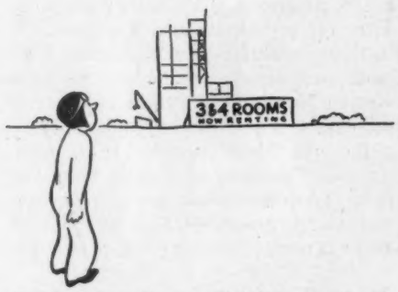
In the first place, the court refused to set any arbitrary altitude at which a plane could fly over private property. It ruled that flight lower than 500 ft. did not constitute a trespass unless there is an invasion of the air space that the owner is in actual possession of, or is within "the reasonable possibility of man's occupation and dominion." In other words, as to the upper air space of which the landowner is in actual possession, or which is within the reasonable possibility of his use, he is the preferred claimant. Flight, therefore, could be engaged in at altitudes lower than 500 ft. provided such flight does not invade that zone of air which the landowner actually is using or may reasonably make use of. In considering the merits of the case, the court said that there was no proof sufficient to show that flying at less than 500 ft. was a trespass or a nuisance, and therefore refused to grant an injunction.

The significance of this case lies in the court's theory of actual or potential use of the upper air space. In other

(Turn to page 134)

Blowing clouds of dust into a neighbor's yard constitutes a nuisance and the airport owner can be sued.

However, if the neighbor builds a high tower near the airport which serves no useful purpose, he may be sued successfully.



An apartment house adjoining an airport is legal and there is nothing an airport manager can do about it.

In Iowa City a farmer planted a row of tall trees next to an airport. The airport and an airline sued, and forced him to remove them.

Warplane Factories in Germany

Describing a 1939 visit to the Junkers factories, which are the largest in the world

By Paul H. Wilkinson
Consultant, Diesel Aviation

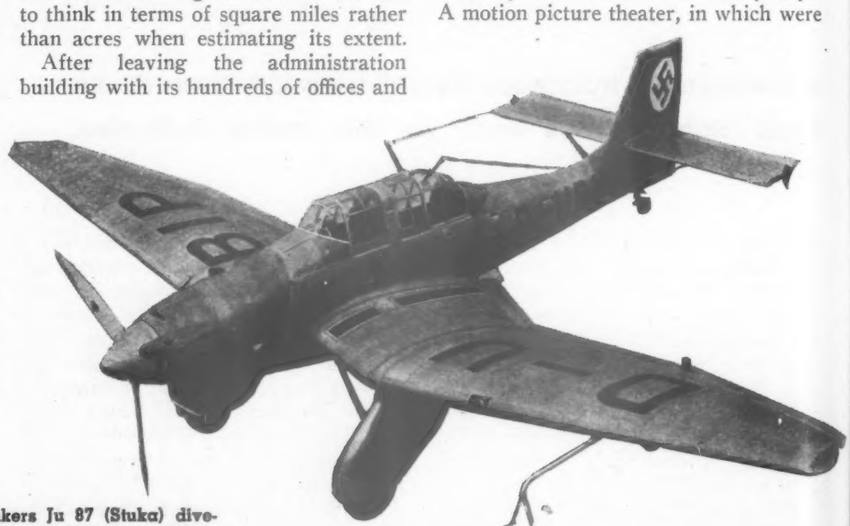
Part II

IN Germany it is the policy for firms in the aircraft industry to specialize in one particular product. Some firms build airplanes (airframes), some build airplane engines and others again build propellers. The firm of Junkers Flugzeug und Motorenwerke A.G. holds a unique position in that it builds all three products—airplanes, airplane engines and propellers. In addition, it manufactures airplane engine test stands.

Since it entered the aircraft industry 30 years ago at Dessau, the Junkers firm has grown and expanded until now it has branches in nine other cities. With 30,000 people employed in its factories at Dessau in 1939, undoubtedly it is the largest aviation firm in the world. Its airplane factories, of which there are five throughout Germany, are known by the designation IFA (or JFA) which stands for Junkers Flugzeug A.G. The four airplane engine factories are known by the designation JUMO which is derived from the original name of the engine factory, Junkers Motorenbau G.m.b.H. These two divisions were combined under the present management and name in 1937.

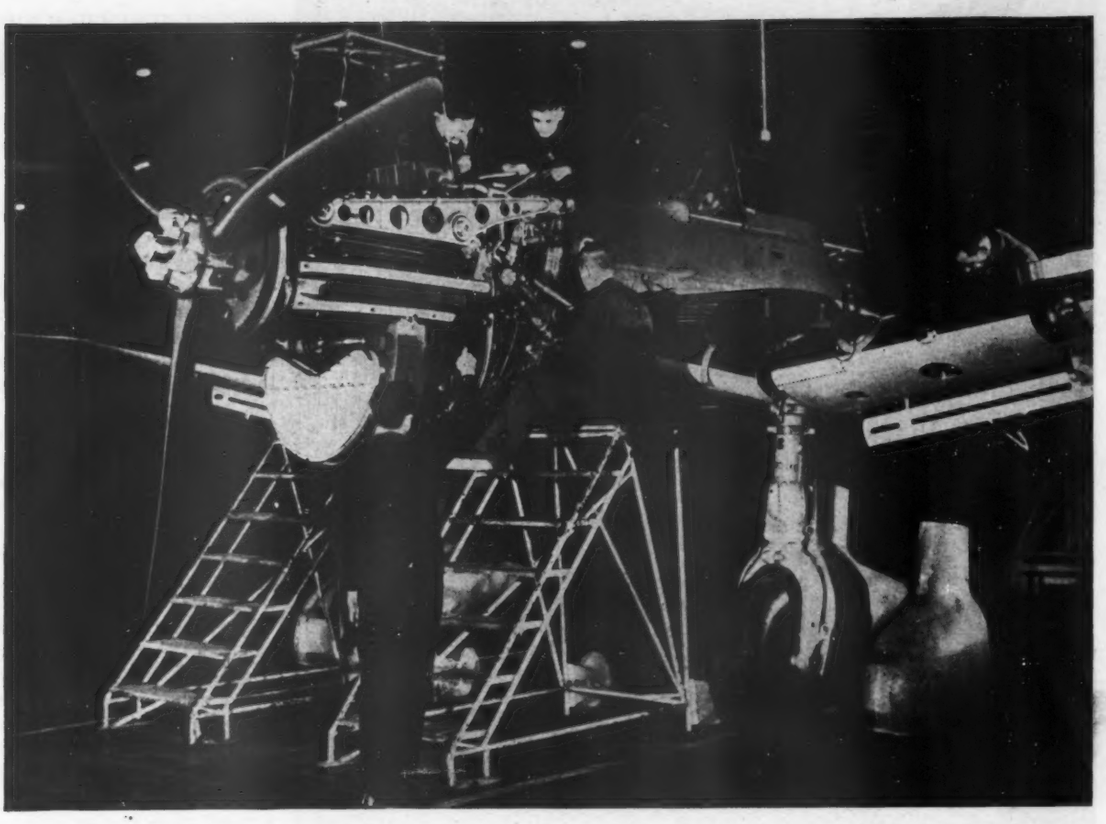
When one visits the Junkers headquarters at Dessau one is taken to the IFA or airplane factory, first. Right inside the gatehouse is the main administration building which is ultra-modern in every detail, even to anti-aircraft guns on the roof. Taking an elevator to this point of vantage one sees the airplane factory close at hand, then a large flying field with numerous hangars, and in the far distance a group of buildings constituting the Jumo factory in which the airplane engines and the propellers are built. So large is the area covered by this manufacturing center that one has to think in terms of square miles rather than acres when estimating its extent.

After leaving the administration building with its hundreds of offices and attractively appointed private dining rooms, one emerges onto wide paved streets leading to the factory buildings. These buildings are separated by plots of grass, planted with trees and flowers in many instances, and contain rustic seats on which the employees can relax during the noon hour. Here and there are large grass-covered mounds with concrete steps leading down to air-raid shelters deep in the ground. To the left of the administration building is the Junkers museum, in which scale models and full-size exhibits depict the progress made by the firm since the early days. A motion picture theater, in which were



A Stuka dive-bomber, the Ju 87.

View of the mass production of Junkers Ju 87 (Stuka) dive-bombers in one of the Junkers production factories. Stukas won the campaigns in Poland, Norway, Holland, Belgium and France for the Germans in conjunction with their mechanized equipment.



The 1,200 hp. Junkers Jumo 211 gasoline engine is mounted in a Stuka dive-bomber by means of cantilever supports.

The main administration building at the Junkers factory at Dessau is a seven-story steel frame structure with anti-aircraft guns on the roof. Air-raid shelters are provided for all the employees.

shown some interesting films of the production of diesel aircraft engines and their use in civil and military aircraft, is part of this museum.

The principle activity in the airplane factory at Dessau is the development and small-series production of new types of airplanes for military and civil purposes. In the case of war planes, the approved types ultimately are allocated to the firm's production factories in other cities where they are built by the thousands. Last year the war planes in small-series production at Dessau included the four-engined Junkers Ju 89 bomber modeled after the Ju 90 40-passenger airliner, the two-engined Ju 88 fighter-bomber which is now in mass production, and a number of three-engined Ju 52 transport planes for parachute troops and two-engined Ju 86-K fighter-bombers powered with Jumo 205 diesels.

At that time, the Junkers Ju 87 dive-bomber was being built in large numbers for the Luftwaffe in the production factories. The accompanying photograph shows the fuselage assembly hall in one of these factories with six flow lines and nearly 100 fuselages complete with landing gears and wing stubs on the floor. The fuselage consists of an upper and a lower shell, placed one upon the other, and riveted together. The mounting of the 1,200 hp. Junkers Jumo 211 gasoline engine in the airframe is facilitated by an overhead crane.

The Jumo engine factory at Dessau is quite a ride by automobile from the airplane factory and covers approximately the same area of ground. It is a self-contained unit with its own administration building and defense system. Last year mass production of 1,200 hp. Jumo 211 gasoline engines equipped with direct fuel injection was in progress in the numerous well-equipped buildings. Standardized power units comprising an 880 hp. B.M.W. 132 radial and its oil tank, fire-wall and plug-in connections and controls also were being built. These power units can be used to replace the engines in Junkers Ju 90 and Focke-Wulf Condor airliners and the replacement of an engine is made in less than 30 minutes. Controllable-pitch and constant-speed propellers were being manufactured in several of the buildings.

Passing through the wide aisles in the buildings it was noticeable that

(*Turn to page 122*)

equipment represents a great improvement over the present permanent station and will allow the pick-up system to be used more conveniently.

Another feature of the new system is that the pick-up hook instead of trailing free at the end of a 55-ft. cable at the time when contact is made, is now held in position and guided through the ground station by an arm that retracts into the fuselage (see photograph). This arm is 15 ft. long and prevents the pick-up line from slipping in turbulent air and greatly increases the efficiency of the pick-up operation. Also by using this guided hook, the line to the plane has been shortened and the ground station is now 20 ft. high instead of 40 ft.

Inside of the plane a power-driven unit has been substituted for the hand-operated pick-up mechanism and together with this a new shop device makes it possible to pick up heavy loads. During the process of releasing the mail from the airplane and delivering it to the ground, a delivery container is attached to the retractable arm just above the pick-up hook and is released by the pilot through an electrically controlled mechanism. Previously the container used to trail from the plane at the end of the transfer rope.

Replacing the high steel mast of the present type station, the poles for the

(*Turn to page* 126)

AIR MAIL PICK-UP

THE successful operation of All American Aviation air mail pickup system for the past few years has caused a great deal of interest throughout the industry. Recently the company announced a new system by which they will collect air mail and air express. This equipment will be installed on all of the company's five permanent air pick-up routes which were recently authorized by the Civil Aeronautics Board.

The new equipment is designed to increase the normal speed of making pick-ups from around 90 miles an hour to 110 miles an hour, and will have a normal load capacity of 50 lb. However, during operations the pick-up loads are limited to 20 lb. In addition to this there will be installed a portable ground station which can be dismantled when not in use. The development of this

S. C. Plummer, Chief Engineer of All American Aviation adjusts one of the bamboo ground poles. (left) Inside the plane a motor hoist draws the hook up, as shown above, between pick-ups.

Aviation's Broadening Markets

By Selig Altschul

AIR EXPRESS contributes about 3 percent to the total revenues of the air transport industry. Yet, as reported a few months ago, this source of income has engaged the attention of many interested groups outside of the aviation industry.

Many plans for cargo plane operations have been advanced since the airplane was invented. Of recent origin is a proposal to incorporate air freight operations with the joint participation of the railroads, airlines, and the Railway Express Agency.

One contention advanced is that the railroads have the facilities to contribute volume to the airlines, hence the latter group should participate in this project. It is further argued that should the air carriers start freight operations on their own, the railroads will take action to retain their traffic.

It is interesting to note that air travel has made serious inroads upon Pullman and first-class rail traffic. Generally speaking, including all cost elements, air travel is higher than first-class rail transportation. Yet, what were the railroads able to do to counteract this trend which still shows no signs of abating? The airline partisans say further that the railroads could have maintained, at one time, that inasmuch as they controlled the bulk of the passenger traffic, they were in a position to turn over such volume to the air transport industry; hence there would be no need for the latter group to have solicitation and related departments to promote air travel.

Apropos of this whole discussion, it is particularly noteworthy to quote Mr. E. P. Warner, now vice chairman of the CAB and one-time editor of AVIATION, who in the August, 1932 issue of this magazine stated:

"The attitude of the railroads toward the airplane is following a cycle which has characterized their demeanor toward every transport innovation. First contemptuous, then patronizing, then alarmed, and finally cooperative or absorbent.

With the motor bus the railroads have passed through all the preliminary stages and are well established in the last. . . . In dealing with the airlines they have, as a whole, so far attained only the second of the four divisions. . . .

Railroad traffic departments are just now beginning to show their realization of the fact that the airplane is going to offer a very hot and troublesome competition, and in a couple of years, if precedent holds good, they will begin crying aloud for someone to save them from the new menace."

Although written in 1932, this statement appears to carry a prophetic ring.

While all current air freight proposals must perforce submit to further studies and investigations, it is generally believed that no tangible action may develop for some time to come.

A special cargo plane, which will reduce ton-mile cargo costs substantially below those of existing aircraft, would be absolutely essential for air freight operations. While designs for such a plane may be currently available, it will take a considerable period of time to actually build such a ship.

Furthermore, the National Defense Advisory Commission must approve all orders for planes now placed with the manufacturers. Any aircraft builder probably would experience considerable difficulty in accepting orders for a plane not already in production and requiring extensive engineering work.

Little doubt remains, however, that the practical realization of air freight operations on a volume basis will require the air transport industry to reappraise its position among the nation's transportation agencies. It is small wonder indeed that the railroads, allied railway organizations, freight forwarders, and others, are all trying to get in on the "ground floor" on something which is very much up in the air at the present time.

As the discussion of air freight will probably continue unabated for some time, it is likely we will have more to say on this subject in a subsequent issue.

The standardization of American and British airplane designs have a number of implications which may exert a profound effect on the aircraft industry for many years to come.

Uniform specifications to cover the manufacture of planes simultaneously for the American Air Services and the British, is bound to permit the mass production of equipment more rapidly than ever before. Such a move may also indicate that many of the planes now on order for the American Army and Navy may ultimately wind up with the British instead. This inference may be found in Secretary of the Navy Knox's statement that it is more important to have the capacity to produce planes rapidly than to have a large fleet of planes, partially obsolete. Only "a reasonable fleet," it was stated, should be kept on hand, plus a large aircraft industry.

To implement this policy, planes could be turned over to England after the American forces attained a certain level, with modern ships reordered for our own Air Corps. The Army and Navy would turn back planes to the manufacturers who would give the United States credit against future orders and resell the "old" planes to Great Britain.

This procedure would extend the industry's backlog of unfilled orders and improve the outlook for future business. Moreover, as greater foreign

(*Turn to page* 110)

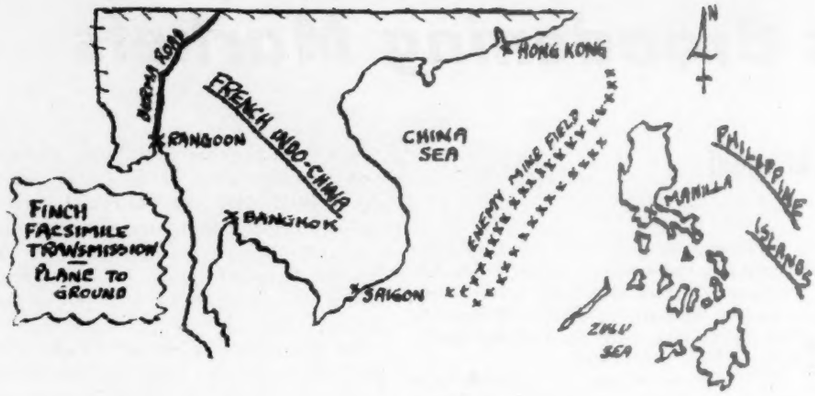
TABLE I

Estimated Results for 1940

	Estimated 1940 Mail Revenue	Estimated 1939 Net Income	†Estimated Net per Share
American Airlines	$3,950,000	$2,200,000	$3.90*
Eastern Air Lines	1,850,000	1,250,000	2.25
Pennsylvania-Central Airlines	625,000	275,000	1.00
Transcont'l & Western Air	2,750,000	40,000	0.04
United Air Lines	4,100,000	1,450,000	0.96

† Based on present capitalizations.
* Assuming conversion of debentures.

	BARRON's Aircraft Average	BARRON's Air Transport Average	BARRON's 50 Stock Average
Sept. 13	36.55	25.38	74
Sept. 20	38.35	26.38	76
Sept. 27	37.80	25.34	78
Oct. 4	38.78	28.09	79
Oct. 11	38.10	27.91	76



Finch Facsimile Demonstrated

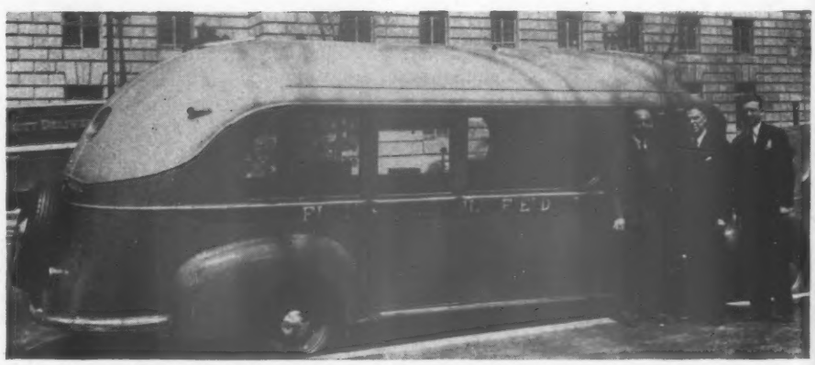
By Don Fink

Radio Editor, Aviation

THE first inside information on the workings of the Finch facsimile transmitting equipment was revealed early in October to a small group of newspaper men at the Bendix, N. J., airport. Previous news that the Fincn Telecommunications Co. had been supplying the recording units to the British, under an older French order taken over after the fall of Paris, had led to the assumption that the British were actually applying radio facsimile transmissions to aerial maneuvers. Whether or not this is true, it was shown conclusively at Bendix that the job can be done. An eight-place Fokker, the property of the Finch organization, was fitted with a standard duplex facsimile outfit identical to those shipped abroad. It was demonstrated in connection with a frequency-modulation transmitter, which has advantages over the amplitude-modulated type not only in freedom from noise and interference, but also in the ease with which voice communication can be multiplexed over the same channel. Two receiving points were set up, one in a mobile trailer-laboratory, and the other in a fixed location in one of the airport buildings. From the latter point, the transmissions were relayed by land wire (ordinary telephone connection) to the Finch plant, some 7 miles away.

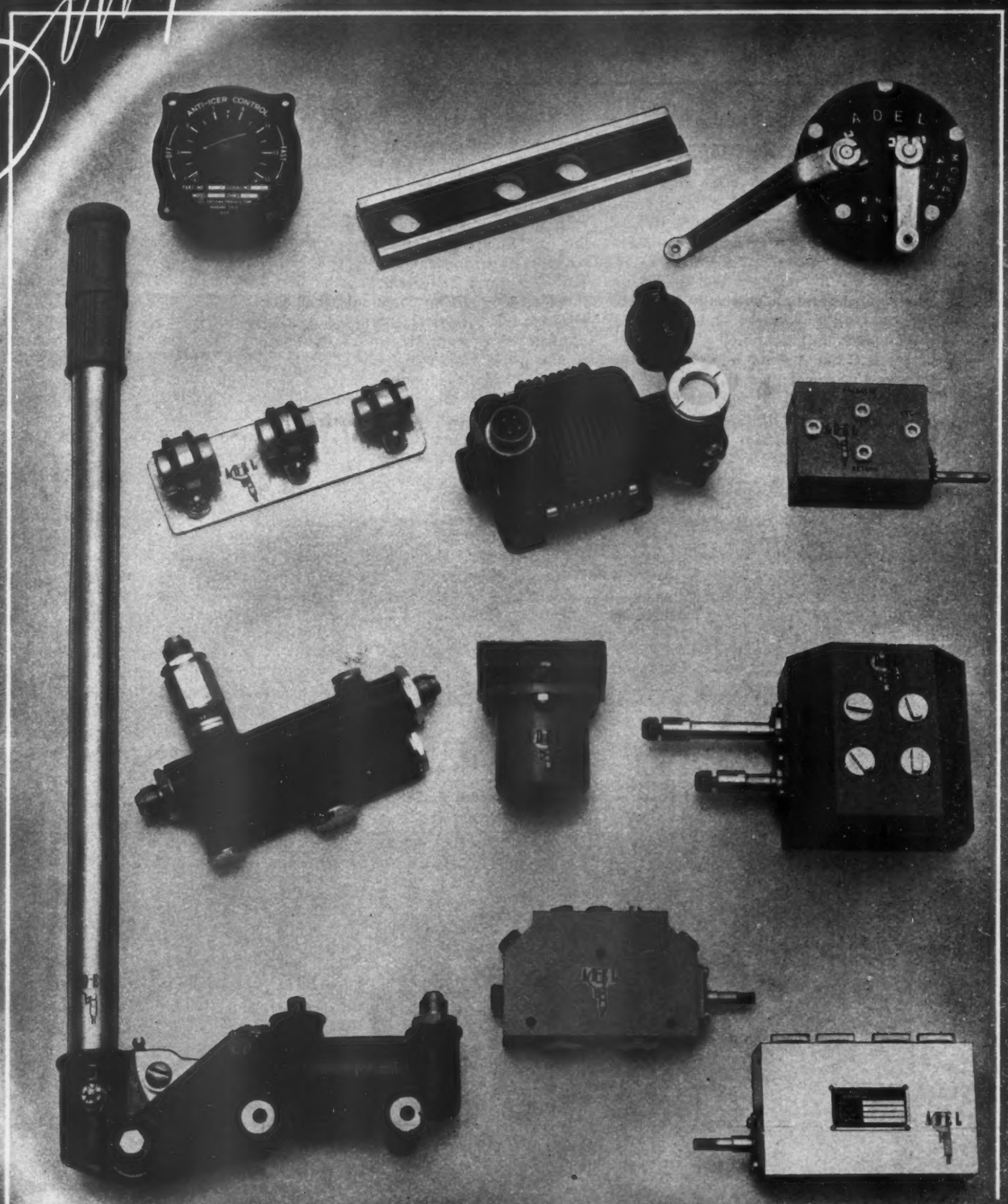
The duplex equipment weighs only 35 lb., exclusive of power supply and the radio transmitting and receiving equipment. Briefly, the equipment may be used to replace the microphone of any voice transmitter (operated at zero db, or six milliwatts at the microphone jack), and to replace the loudspeaker of any voice receiver having an audio output of 5 watts. The audio frequency

(*Turn to page 132*)



Top: a map that was transmitted from plane to ground. Above: a roving laboratory. Below: l. to r., battery box, scanning mechanism, amplifier.

Simplicity



Eastern Engineering Sales Representative
J. HENRY REISNER
Hagerstown, Maryland

ADEL PRECISION PRODUCTS COR
231 SOUTH OLIVE AVENUE, BURBANK, CALIFORN

Aviation—RADIO

Dialing the Air Waves with Don Fink

Two New Lear Releases

A new automatic direction finder, the ADF-8, and an accessory indicator combined with a gyro compass are two of the latest releases from Lear Avia, Dayton, Ohio. The new radio compass, under CAATC numbers 345 to 350, is distinguished by an unusually complete remote control panel, shown in the accompanying photograph. The equipment is elaborate—the superheterodyne employs no fewer than 19 tubes and the total weight is 60 lb., but the performance takes in everything for which this type of equipment can be built. The standard model has six frequency bands 148.5-327, 320-705, 690-1518, 1485-3265, 3200-7050, and 6900-15,200 kc. Communication on all six bands is provided, with automatic loop direction finding on the first four named. An airline model covering the ranges 195-405, 540-1295, 1275-3050, and 2910-7000 kc., the first three on loop, all on communication, is also available. Crystal controlled local-oscillator frequency reception can be supplied, and a cw beat-frequency oscillator is standard equipment. The 12- or 24-volt dynamotor for B supply is mounted directly on the receiver chassis.

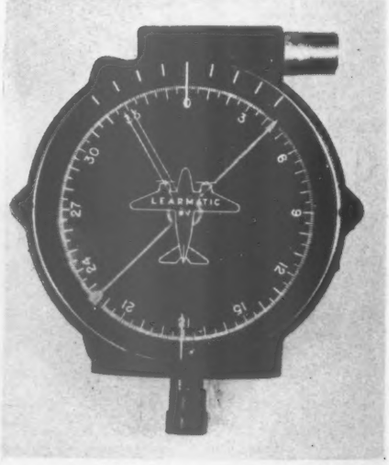
The remote control panel has a switch for selecting the various functions of the receiver: communication reception on loop or fixed antenna, direction finding using automatic indication, automatic bi-directional finding (using two loops, one for sense determination). Direction finding by manual rotation of the loop, using aural indication in headphones or visual null on the signal strength meter, may also be performed. The remote panel contains also the output volume control, the tuning control, a straight-line type tuning indicator, the band selection switch and the signal strength meter.

In automatic direction finding, with the motor-driven loop, three methods of azimuth indication are possible: direct mechanical drive or electrical indication using a.c. autosyn or d.c. selsyn rotators. The equipment is mounted in a standard ATR rack mounting. Two separate audio output channels, and an interphone system are provided, as well as a noise limiter which operates on ignition and other steep-wavefront interference.

An auxiliary type of azimuth indicator, the Lear-matic, is available for use with the ADF-8. This indicator combines the indications of two instruments, the automatic radio direction finder and the gyro compass. A long arrow indicates the loop direction while two parallel lines are used as the gyro compass index. On the face of the instrument is an image of a miniature plane, with a fixed lubber line. In flight the pilot keeps the radio d-f index and the gyro index lined up, one over the other, after an initial setting of the gyro at the bearing toward (or away from) the radio station. The flight under this condition must be a straight line over the ground, and the angle between the two indices and the lubber line of the miniature plane is the crab angle necessary to correct for drift.

Remote Control Panel of Lear AFD-8 Direction Finder

Signal chassis of the Lear ADF-8

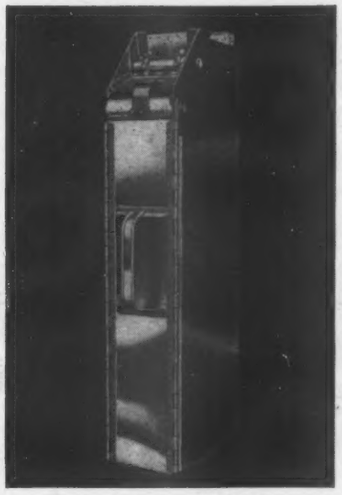


Lear-matic Indicating Dial

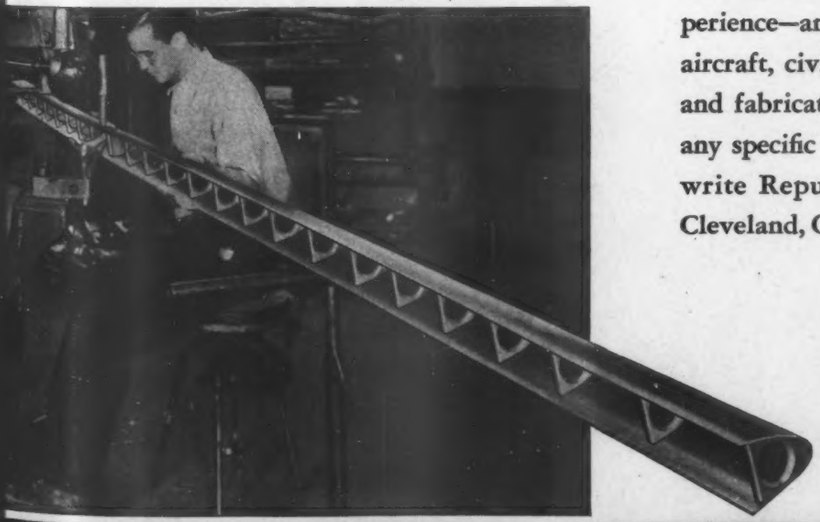
Ceiling Unlimited

For Aircraft Applications of *Republic Enduro* STAINLESS STEEL

Above: *Fire wall*—Below: *Ammunition box and ammunition chute—all fabricated from* ENDURO *Stainless Steel.*



Below: *Wing nose section, made of high tensile* ENDURO *Stainless Steel by the "*SHOT WELD*" process.*



● High strength-weight ratio resulting from the high physicals of Republic ENDURO* Stainless Steel is one of the primary reasons for its increasing use in aircraft structurals. Retention of strength at high temperatures explains why Enduro has become so universally accepted for manifolds and collector rings. High corrosion-resistance dispenses with the use of weight-increasing lacquers and makes it invaluable for exposed parts and fuel tanks. Its toughness and ability to resist shock give it front rank among materials that contribute to greater flying safety. ● ENDURO is a product of Republic—one of the pioneers in the making of stainless steel in America. Since the first epoch-making heat was poured years ago, Republic metallurgists have produced many different analyses of stainless and heat-resisting steels, including the high tensile and full-hard grades now so greatly in demand. They have followed closely all aviation applications—have amassed a wealth of time- and money-saving experience—and will work with any maker of parts or aircraft, civil or military, in the selection, application and fabrication of the correct grade of ENDURO for any specific use. ● For more complete information, write Republic Steel Corporation, General Offices: Cleveland, Ohio; Alloy Steel Division, Massillon, Ohio.

BERGER MANUFACTURING DIVISION
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UNION DRAWN STEEL DIVISION
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INTO "HIGH PITCH" FOR DEFENSE

Having just completed doubling the size of our plant, work is already under way for a further major expansion. Thus by anticipating defense needs, ever increasing numbers of Ryan metal low wing trainers take their important places in the training programs of the U. S. Army Air Corps, the U. S. Navy and foreign governments. Ryan Aeronautical Co., San Diego, California.

Ryan

IN VOLUME PRODUCTION FOR U. S. ARMY AIR CORPS AND U. S. NAVY

Typical sub-assembly layout boards in the hull department of Consolidated Aircraft Corp. By the Taper-Van Dusen reflection printing process, these boards are all laid out for attachment of form blocks without pencil markings or hand operations.

Multiple Duplication of Assembly Fixtures by the Taber-Van Dusen Method

"SPEED UP!" That is the cry which is driving the entire aircraft industry to superhuman efforts in meeting present national defense needs for more and better aircraft. It has become apparent that the most vital factor in the present situation is not money, or men, but time. We must build airplanes much faster than anything we have yet accomplished. And what is of equal importance, we must shorten the time interval between development of the design and translation of the design drawings into completed airplanes coming off the assembly line. The tooling-up interval must be reduced. One day saved in tooling may be worth ten airplanes. And ten airplanes may be the difference between winning or losing a battle of world importance.

A great problem of tooling has been the construction of assembly fixtures for shaping the many frames and sub-assemblies which go into the complex structure of the completed airplane. Construction of such fixtures has been a tedious process which amounted to a serious bottleneck in the production scheme. We are all familiar with the wide application of ship lofting methods to aircraft production.

THE AUTHORS: left, Philip Taber, engineering department, Consolidated Aircraft, and instructor in lofting, San Diego State College; right, L. W. Van Dusen, production department, Consolidated Aircraft Corp.

It has been the practice of all major aircraft builders to lay out hull lines and other contours of the airplane full scale on loft boards. These full-scale layouts are made with extreme accuracy and from them it is possible to scale off various dimensions for the construction of fixtures and assembly jigs. This process of working from full-scale layouts has made interchangeability of parts practical and so has speeded production materially, once the jigs and fixtures were available.

But there has been a big time lag, usually of many weeks, between completion of the full-scale loft layouts and the completion of production fixtures. Such fixtures are usually of wood, in the form of a flat plate, or table, with form blocks located on it for positioning the parts to be assembled into a frame or structural unit. Each such table has to be laid out with the greatest accuracy with reference to the original full-scale loft lines in order to insure the all-important interchangeability of parts. For production purposes a group of six, ten, or more identical fixtures is often provided for simultaneous production of multiples of a given assembly, such as a rib, hull frame, etc. Yet even under the most favorable conditions it

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Getting the Most Out

As aircraft orders pile up to dizzy heights, an increasing volume of work is turned over to sub-contractors. West Coast factories have found that the only clear way out of the maze of confusion in the small shops is through the use of machine loading charts. This is the first of three articles on machine loading.

By C. W. S. Parsons *M.E., Consultant*

A VITAL PART of the aircraft industry is that institution known to airplane manufacturers as "outside production." It is an institution because it began when aircraft making was born in this country more than a quarter of a century ago, and it developed with the industry. It is the creation of enterprising men.

These men in the outside machine shops are master mechanics. Through the years they have stood ready to puzzle out and fashion in metal the intricacies of design that satisfy the souls of aeronautical engineers pursuing the will o' the wisp of least air resistance, and the phantom of new and untried mechanical techniques. They have struggled with odd angular conceptions in three-dimensional space thought out by technical men whose hitherto known propensity was to make everything rectangular, symmetrical, and balanced.

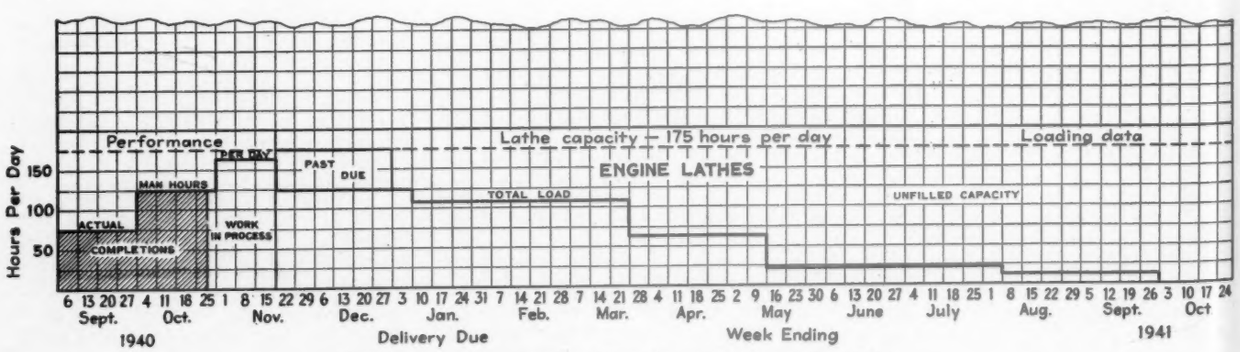
Primarily these men have machined castings, forgings and pieces of bar stock and tubing to make a big share of the twenty odd thousand parts outside of rivets in a modern, all-metal airplane. In addition, these men doing outside production have taken on building sub-assemblies and performing specialized operations such as welding, plating, grinding, heat treating, and to a less extent sheetmetal work. They do production tooling. But mainly these men with job shops have carried perhaps 75 percent of the parts-machining load.

As 1940 broke, the load on the shops was building up fast by reason of French and British airplane contracts. It was no longer a question of hand to mouth operation on one shift with a fraction of the available equipment. By spring the shops were hunting for men capable of coping with the vagaries of dural under cutting tools. Second and third shifts appeared. Business zoomed. But with it came grief. Orders piled up. "Past due" work tangled operations. Shop supervision was harassed by a young army of follow-up men from the aircraft factories making daily rounds trying to pry loose parts needed for ships waiting on assembly lines.

If the war orders were educational in intent certainly the industry was finding out plenty. From the shops came the cry that the trouble lay with the factories. Orders were coming in bunches. Many were past due when received. The factories were not furnishing the material on time to meet the due dates. Nor the tooling! It was costly to build up man power and then lay off men because there was not enough work for them. The temptation was great to take any orders offered, regardless of due dates, to be sure of continuous operation.

In some instances the overload was terrific in spite of certain machines standing idle from time to time. Time wasted tearing down set-ups to run a few parts on "hot orders" became a serious problem. Stop-orders holding up partially fabricated parts while engineers huddled over design changes added to the confusion. Some factories failed to furnish excess parts to provide for normal spoilage, creating controversies over whether to set up machines specially to fill the shortages or to wait until other orders for the same parts came through.

The shops strained themselves to the limit to please their sources of bread and butter. But many found themselves caught in the web of overnight expanding aircraft factory organization, where former personal relationships and more informal methods of procedure no longer


Performance
Lathe capacity — 175 hours per day
Loading data
ENGINE LATHES
PER DAY
PAST DUE
MAN HOURS
ACTUAL COMPLETIONS
WORK IN PROCESS
TOTAL LOAD
UNFILLED CAPACITY
Hours Per Day
150
100
50
6 13 20 27 4 11 18 25 1 8 15 22 29 6 13 20 27 3 10 17 24 31 7 14 21 28 7 14 21 28 4 11 18 25 2 9 16 23 30 6 13 20 27 4 11 18 25 1 8 15 22 29 5 12 19 26 3 10 17 24
Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct
1940
Delivery Due
Week Ending
1941

A typical machine loading chart for use with engine lathes.

# of Machines

quite seemed to serve. From the factory point of view, much of the trouble seemed to be with the shops. Even though much raw material was not coming in from sources of supply, the records showed all those past due orders in the shops, with material furnished. The indications were that some of the shops failed to put through orders according to priority of due dates (though due dates sometimes meant nothing with orders due before being received). It was apparent that some shops accepted all orders on the theory that they must have a backlog in case orders stopped flowing next week, which happened often.

It is significant that the buyers were still depending upon word of mouth assurance of ability to handle work, based for the most part on the shop men's judgment of work on hand and inspection of the racks. It is questionable whether a more reliable method of estimating the situation existed. But certain facts speak for themselves. The shops were not getting a satisfactory continuous flow of orders, with tooling, material and information available, ready to run. Pushing out future orders to keep the shops busy only served to create confusion when hot orders suddenly broke loose as material arrived and follow-up men set to work to jam enough parts through to take care of ships on the assembly line.

With the arrival of ship contracts for hundreds of planes it became necessary to put work out to job shops on a week-by-week or month-by-month delivery schedule basis, with material being fed the shops in measured-out lots. No human beings, let alone buyers or aircraft parts makers, could be expected to bear in mind the distribution of load according to delivery schedules after a few thousand such orders began to feed out among a few score of shops from a dozen different factories. Nor could they visualize which groups of machines were being loaded to capacity, and which not.

Naturally the factories set up various means of checking their parts lists, as part of material and parts procurement. In fact these set-ups themselves have gone through a drastic evolution in the face of the mounting volume of business. But it remained for Walter Hamilton, of Douglas Aircraft Company, to inaugurate last Spring an internal effort in that organization to analyze the capacities of the various outside production shops and to seek a way to chart their loads by major operation groupings, with relation to delivery promises.

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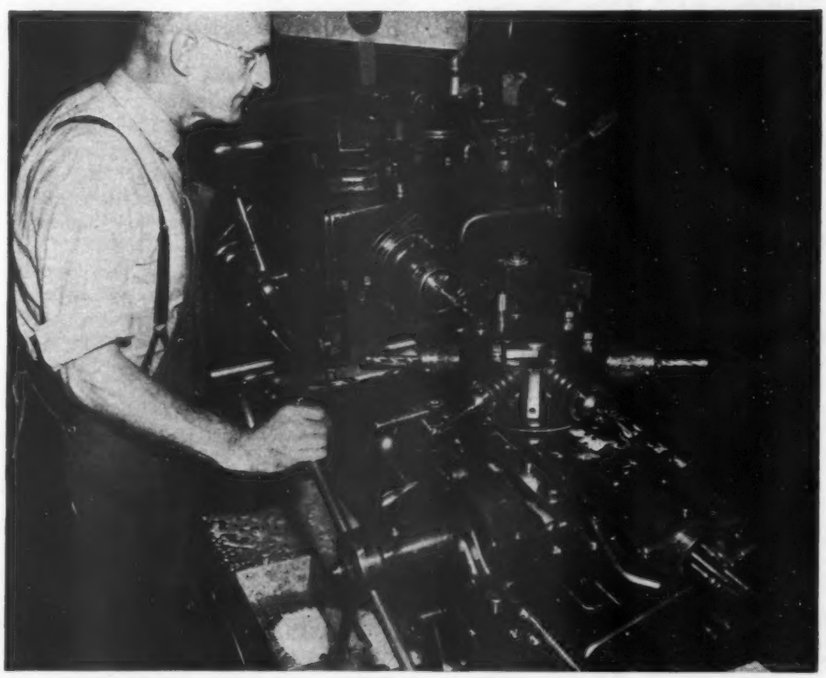

Above: a Warner & Swasey turret lathe operation in the Douglas Aircraft machine shop. Machine loading charts must be kept to employ fully such equipment. Below: general view of the machine shop operated by Interstate Aircraft & Engineering Corp., El Segundo, Calif. Sub-contractors of this type have been swamped with orders for aircraft parts.

Cutting Production Costs

One manufacturer saved 88 percent of the cost of turning out 500 parts by using die casting rather than conventional methods. This is how it is done.

Fig. 6. This control pedestal is die cast in two halves and, when ready for use with machining done costs less than one eighth as much as the equivalent machined sand cast pedestal.

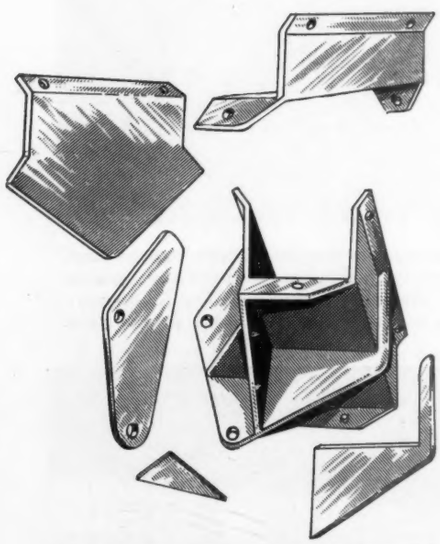

Fig. 2. Shock absorber part, for flaps, as produced in die cast form. In several of the drawings on this page the completed die casting is shown, as is also the number of component parts that would be necessary to build the same piece out of other types of material. From this one of the main advantages of die casting can easily be seen.

DESIGNERS of aircraft and aircraft parts doubtless have been familiar in a general way with the economies and other advantages of die castings for many years. Not until recently, however, have they been able to make extensive use of die castings. Several conditions have arisen to bring about this "discovery" of the availability of die castings for aircraft applications. In the first place, the number of duplicate parts required has increased greatly with much larger orders for duplicate ships. This often makes it feasible to construct dies required for the process whereas, heretofore, the cost of the die was not justified for the smaller number of parts needed. Secondly, the casting process has been improved and extended to include magnesium alloys which, until recently, involved casting problems not fully solved. In the third place, improved casting machines, including some of larger size, were needed and had to be developed. It was necessary also to improve casting technic and highly desirable, if not essential, to find ways of making dies at lower cost.

Today, all these conditions have been met and the demand for aircraft parts in moderately large quantities is such that the die caster who is equipped for turning out parts suitable for aircraft finds his plant laboring under difficulties to meet the demands of aircraft makers because so many die castings are wanted. The aircraft designer has discovered not only that, when properly made, the die casting meets his needs for certain types of parts, but does so with marked economy and often with a phenominal increase in production rate. These are important not only in themselves but also because they release certain types of skilled labor, such as welders, for example, and also sometimes considerable machining equipment, especially where the die casting can be substituted for sand castings.

Before dealing with specific applications of die castings, it is desirable to point out some of their limitations, as well as their advantages, to say something as to the alloys available, and to briefly describe the casting process. Die castings naturally share certain limitations with other castings and, like them, make necessary the use of higher factors of safety than for wrought alloys, partly because the castings are subject to porosity. In general, their strength does not equal that of similar wrought alloys and they are less ductile, as a rule. For these reasons, die castings are not recommended for highly stressed parts. Although they are sometimes used where stresses are quite high, their makers do not favor such applications. The chief applications are for parts in which stresses are low, yet they are sometimes substituted with great advantage for welded assemblies commonly made from sheet metal or tubing and can even be used at times in place of parts machined from bar stock as well as in place of sand castings.

A great advantage of the die casting is that it can often be made in a complex shape with thin sections, the latter often being varied in thickness, much as in sand castings, so as to proportion thickness to the stress or to provide convenient bosses, bearings, fastening parts and the like. Also exceedingly important is the ability to hold much closer dimensional limits than are feasible in sand castings and sometimes than in stamped parts. Often, holes can be cored accurately, and even in small sizes. It is a simple matter to cast external threads and cable grooves, although these are likely to require subsequent chasing. Surfaces are usually much smoother than those of sand castings and, when allowance for machining is needed, very little metal need be removed in the machining process. Often the only machining necessary consists in reaming or tapping holes, once the flash, which occurs at parting lines, has been removed, this latter being done nearly always by the die caster.

Since minimum weight, consistent with adequate strength, is a primary requirement for nearly all aircraft parts, the alloys of magnesium and of aluminum are most often selected for aircraft die castings. Although specifications for zinc alloys are approved by both Army and Navy, and such alloys are

by Die Casting

By Herbert Chase

Mechanical Engineer

easiest to die cast, are stronger and especially are higher in impact strength than the magnesium and aluminum alloys, and are lower in cost per casting (which accounts for their widest use in other applications than those in which minimum weight is needed), the zinc alloys are rather heavy and so are not much used for aircraft parts. Alloys based on copper, which are the strongest of all suited for die casting, have limited use in aircraft. Their chief disadvantage is their weight and the fact that, because of their much higher melting point than the aluminum and magnesium alloys, die life is shorter, although more than adequate for the number of castings commonly needed in aircraft applications.

A large proportion of die castings used in aircraft are produced in so-called "cold chamber" casting machines, in which the metal, in either completely or semi-molten form, but usually at or very close to its melting point, is ladled by hand into the "cold" chamber, in roughly measured quantity slightly greater than that needed to fill the die cavities. Immediately thereafter, the metal is forced into the die by a hydraulically operated ram which applies a pressure of several thousand pounds per square inch. During this injection, the die is locked, usually by a toggle mechanism, also operated hydraulically. As soon as the casting has cooled enough to hold its shape, the die is opened and the casting (or more than one, if the die has multiple cavities) is ejected along with the gate and the slug, the latter containing whatever excess metal was supplied. This process of making the casting is used exclusively in the plant of the Harvill Die Casting Corp., Los Angeles, the largest producer of aircraft die castings on the Pacific Coast, and the maker who supplied all the die castings here illustrated as well as the data regarding production costs given below. After casting, the parts are transferred to other departments where flash and gates are removed and any machine work specified is done. All die castings in magnesium alloy are also subjected to a chromate treatment which inhibits corrosion and acts as a base for synthetic finishes.

The rate at which die castings are produced varies somewhat with the size and nature of the casting but, for a single cavity die, averages around 500 castings in eight hours. If, as for many small parts, the die has two or more cavities filled simultaneously at one "shot" of the machine, the output is correspondingly multiplied. Multiple cavities may have the same or entirely different shapes but, as a single day's run may produce enough castings to last the customer a year or more, it is not often necessary, in aircraft work, to use dies with cavities which are exact duplicates.

Some indication as to the saving in labor, possible in a die casting, can be secured by consideration of the de-icer fitting, Fig. 1. The main tube is 8¾ in. long and 19/32 in. i.d. Threaded portions are cast integral on each end, as are the four branch tubes entering the main tube at 45-deg. to the axis. Section thickness is about ⅛ in. and an aluminum alloy is used. The only machine work needed is to chase the threads, which are thus held to Class 3 tolerances, and to remove the flash at

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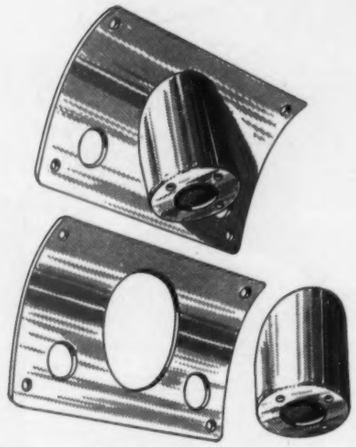


Fig. 3. Aluminum alloy die casting for reading lamp base.

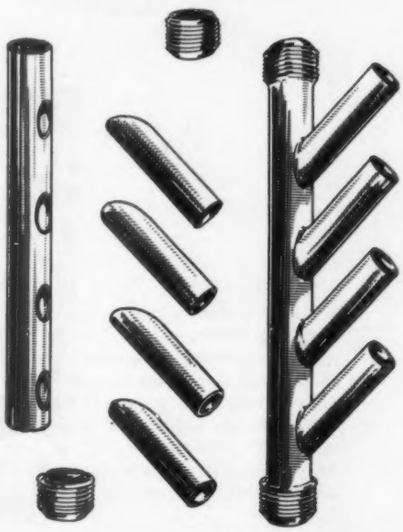
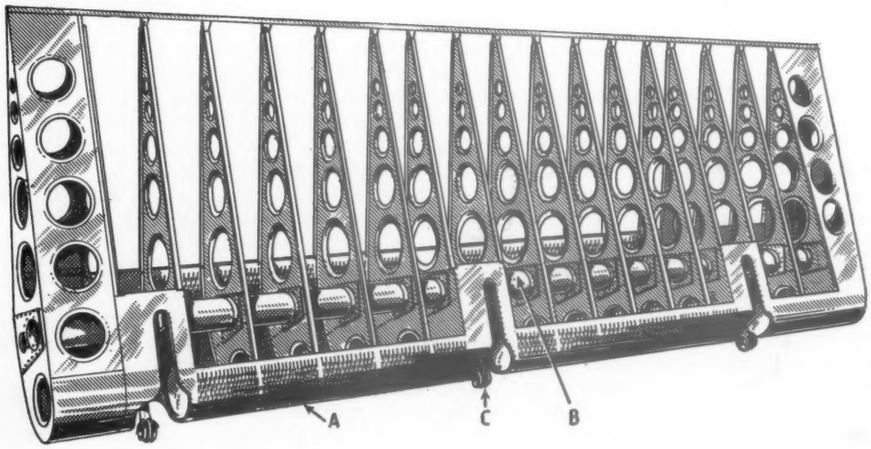


Fig. 1. De-icer manifold, a one-piece aluminum alloy die casting.

Fig. 5. Large die casting in aluminum alloy for a control pedestal, as used by Vultee.

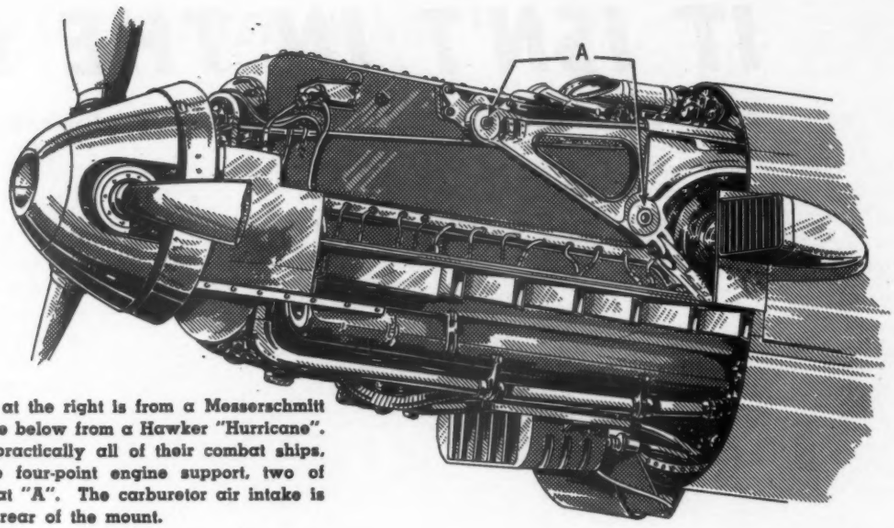
Fig. 4. Manual wheel with drum for control cable, die cast in magnesium alloy.

AVIATION SKETCH BOOK OF DESIGN DETAIL

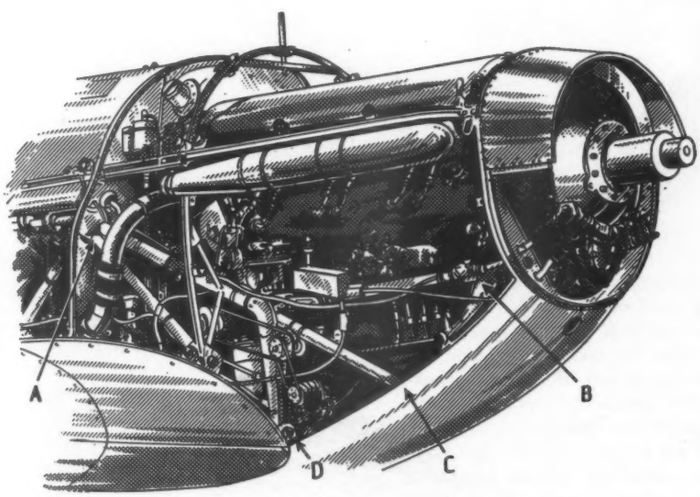


Flaps on the Curtiss-Wright Transport are built in four sections, one of which is shown above. Construction consists basically of a four-inch aluminum alloy tubular spar "B" to which are riveted stamped Alclad ribs. The nose is reinforced with thin sheet, perforated for lightness (A), in order to maintain good aerodynamic contours between the ribs. The flaps are hydraulically operated from a central cylinder located in the lower fuselage. Through a system of cables and rods the flap may be set in any position, ranging from open slot, undeflected position to fully deflected 60 degrees (for the center section flaps).

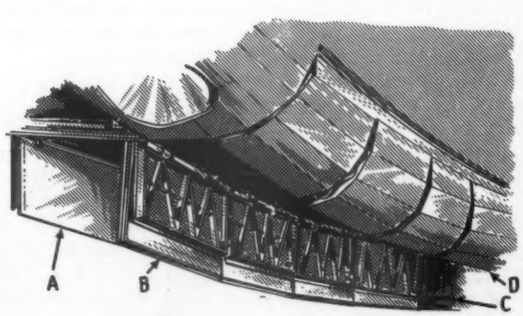
The wheel and landing gear at the left is for one of the Martin Bombers. The first section of the vertical tube extending up from the axel is a heat-treated steel tube having a strength of 180,000 lb. per sq. in. The section just above this contains the telescopic shock strut with a full stroke of 9" and a stroke of 6" from the static load position. Attached to this are the torque arms or "scissors". The landing gear is mounted at the bearing points into a "W" strut forging, with split bearings.



The engine mount at the right is from a Messerschmitt Me 109 and the one below from a Hawker "Hurricane". The Germans, in practically all of their combat ships, have stuck to the four-point engine support, two of which are shown at "A". The carburetor air intake is shown just to the rear of the mount.



The Hurricane engine mount, differing from the German forged type, is of the cradle type supporting the engine through a tubular structure. The mount is attached to the rest of the ship at the point "A" and also at a point at the wing root. From the lower point tubes run out to the point "D" then to "C" and end at "B". The engine is then lowered into this structure. The joints are fastened together by rust-resisting steel fittings.

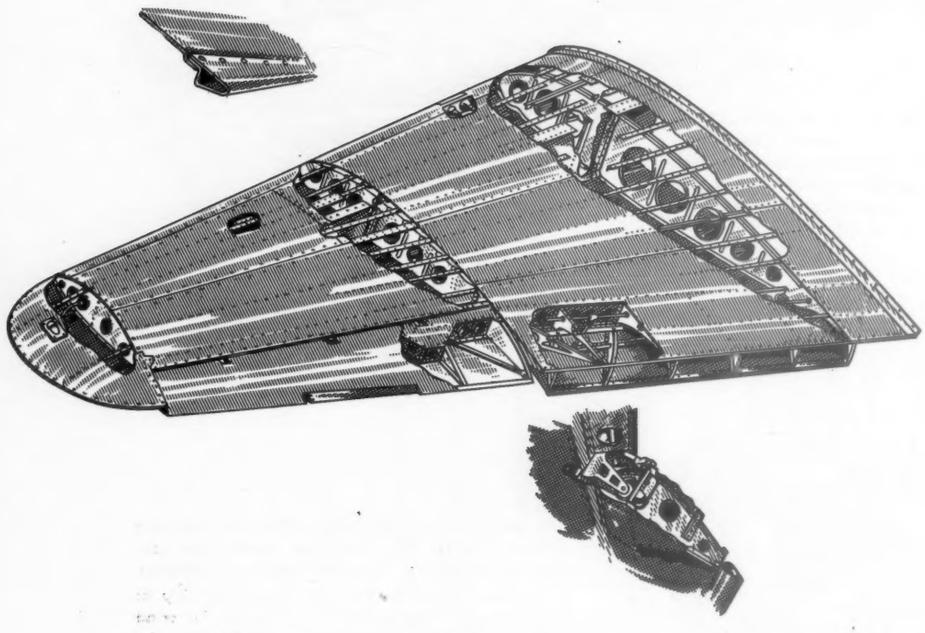


Of interest are the bomb bay doors of the Vickers Wellington bomber. Of truss type construction they are built in sections which "breathe" in and out. The bomb bay is in three sections across the ship. Door "A" is the inner door of the far section, "B" the single center door, and "C" and "D" the two doors for the outside section.

IT ISN'T IN THE BOOK

Engineering Shortcuts that have not yet found their way into textbooks

WING SECTION LAYOUT



A COMMON PROBLEM in airplane design is to determine airfoil ordinates for any thickness and camber ratio, while employing desired types of curves for both profile and camber lines.

In principle (as given in N.A.C.A. No. 460) the ordinates of the basic symmetrical airfoil are laid out on normals to the median camber line, the analytical method being by means of trigonometrical offsets, each of the original points being displaced horizontally and vertically, in accordance with the slope of the camber line. This method, although exact, is tedious for the designer and too complicated for convenient shop use without referring the points back to a common series of stations along the chord as has been done (usually by graphical means) in the case of all the specific airfoils in the standard lists.

The designer, however, may not wish to be limited to thickness percentages in multiples of three, cambers in even twos, etc.; or he may have his own ideas on the general type of curve that will best suit his purposes. Finally he must have a method of smoothly varying certain characteristics along the span of a tapered wing.

Alternatively, sufficient accuracy for practical purposes can be had by interpolating (or extrapolating) between two known sections on a tapered wing. Although this is commonly done by laying out on a loft floor and transferring the measured ordinates to paper, it is easier and more accurate to do the whole job analytically. Laying out an airfoil of specific thickness ratio is particularly simple. Thus if the subscripts 0 and 1 refer to characteristics of the two known sections, the corresponding ordinate (upper or lower) of the desired section (for desired thickness t and camber h) all in % of chord, is:

$$z = z_o - \frac{z'_o - z'}{z'_o - z'_1}\,(z_o - z_1) \qquad (1)$$

the primes referring to ordinates at some particular station, such as at maximum thickness where (with the usual chord line) $z' = \pm\, t/2 +$ camber line ordinate, and the difference (numerical sum) of top z — bottom $z = t$. In the usual case of constant camber, the camber ordinate %, at the maximum section, can be taken from either of the two known sections, which in combination with the desired $t/2$ gives z'. Or if the camber line equation is known, its ordinates can be entered directly as z_1 and z_1 in (1).

Eq. 2 is applicable to a straight tapered wing, where the base sections can be taken at the root and tip or at any other two selected points on the semi-span. If the local chord lengths are c_o, c and c_1 at spanwise distances o, y and y_1 respectively, the actual ordinate dimension at a given percent station on c is:

$$cz = c_o\, z_o - \frac{y}{y_1}\,(c_o\, z_o - c_1\, z_1) \qquad (2)$$

Eq. 3 makes the wing surface elements straight between corresponding points on the two base sections. Assuming these elements extended in straight lines to focal points beyond the wing tip: let y_o be the distance from c_o to where the chord c vanishes; y_{to} the distance to where the thickness tc vanishes; and y_{ho} to where the camber height hc vanishes. Then at any other point y:

$$\text{Chord } c \qquad = c_1 \quad (1 - \frac{y}{y_o}) =$$

$$c_2 \quad (1 + \frac{y_1 - y}{y_o - y_1})$$

$$\text{Thickness ratio } t = \frac{t_1 c_1}{c}\,(1 - \frac{y}{y_{to}}) =$$

$$\frac{t_2 c_2}{c} \quad (1 + \frac{y_1 - y}{y_{to} - y_1})$$

$$\text{Camber ratio } h \quad = \frac{h_1 c_1}{c}\,(1 - \frac{y}{y_{ho}}) =$$

$$\frac{h_2 c_2}{c} \quad (1 + \frac{y_1 - y}{y_{ho} - y_1})$$

If there is a twist angle α, between y_1 and y_o, the twist at any other point is:

$$\alpha = \alpha_1\,(y_o/y_1 - 1)\,/\,(y_o/y - 1)$$

For so-called constant camber (really constant camber ratio), $y_{ho} = y_o$; and if not tapered in thickness ratio y_{to} also has the same value.

By a direct adaptation of (2), any desired linear variation in the leading edge radius or other characteristics of the basic profile equation can be similarly handled.

The sections will ordinarily be those at ribs or bulkheads, but can be in any desired plane providing all in a half wing are parallel to each other. Production facility will in most cases be favored by setting them in a plane that makes approximately equal angles with the top, bottom and L. E. of the wing. Only drafting convenience is ordinarily served by the usual position parallel to the plane of symmetry.

A DIAGONALLY RIBBED WING

THE structure of airplane wings is still a fertile field for design, particularly cantilever wings, many solutions being used to reach the desired end. We find single beam, two beam and multiple beam wings with various combinations of stressed skins, stiffened skins and fabric covering. The monospar wing with variations of the torsion system has been used for some time. Among these is the "D" section type, with the torsion carried by the leading edge covering the beam in combination. This is the arrangement used on practically all high performance sail-plane wings and since they represent an extreme case of high aspect ratio the method is probably good.

A new method was developed during the design of the Erco light airplane, consisting of a single beam braced torsionally by diagonal ribs and a very light rear beam capable of taking moderate compression as part of the chord load system.

What was desired was a light, simple and inexpensive wing constructed entirely of metal except for the fabric covering. The earlier type of bracing with tension tie-rods was considered too complex; and the "D" type formed by a metal skin over the leading edge gives a closed section with rivets accessible on the outside only. In order to avoid blind rivets the nose sheet was made to cover only the upper surface and front portion of the nose ribs, and in this form was inadequate for torque bracing.

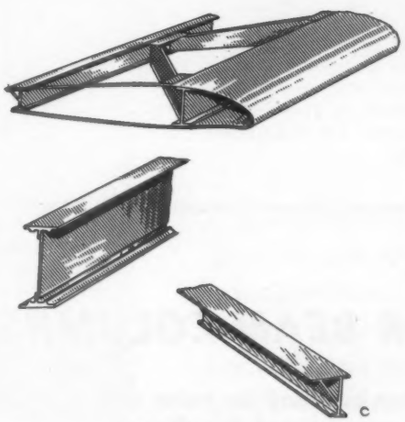
The diagonal rib system which was adopted for torsional and drag bracing is also used to form the contour of the wing between the main beam and the aileron. Using the N.A.C.A. 43013 airfoil, the curvature of the surface is small over the portion of the wing taken up by the diagonal ribs. In addition, the air load flight tends to raise the fabric slightly, bringing the upper surface contour very close to that desired.

The actual structural problem then became the design of, (1) a light main beam capable of carrying the total bending moment with no assistance from any other part, and (2) the diagonal rib system assumed to resist all torsional moments about this beam as an elastic axis, plus the rib air loads, plus the chord components loading these members as parts of a Warren Truss.

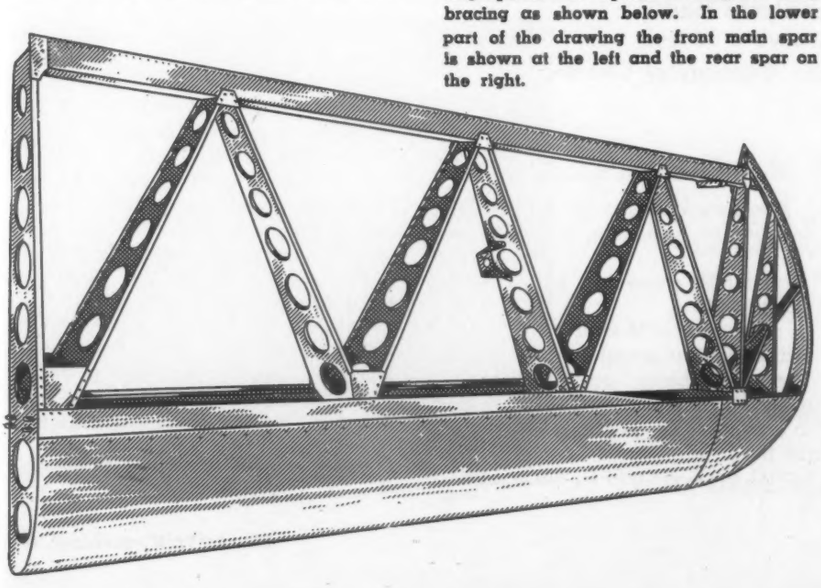
The structure was considered determinate, moments transmitted through the joints or equalized by the rear beam being neglected. Subsequently, proof loads were applied to a completed wing and a deflection analysis made. This showed the original analysis to be substantially correct.

The main beam was of a tension field extruded cap-strip type, not an expensive one to make when an automatic riveting machine is available. These extruded capstrips were machined down in section outboard by means of a milling machine and tapered forms, a refinement necessary from the weight standpoint if a continuous extrusion is used.

Since the wings are not tapered, the ribs are all of the same section except at the tip. This means that there are extremely few different shapes and forms to make, resulting in easy production and assembly. The weight of the complete wing was approximately one pound per square foot, which is a low figure for an untapered, cantilever wing having a thickness ratio of 13 percent.



The new ERCO light plane shown above employs the new system of diagonal wing bracing as shown below. In the lower part of the drawing the front main spar is shown at the left and the rear spar on the right.



IT ISN'T IN THE BOOK

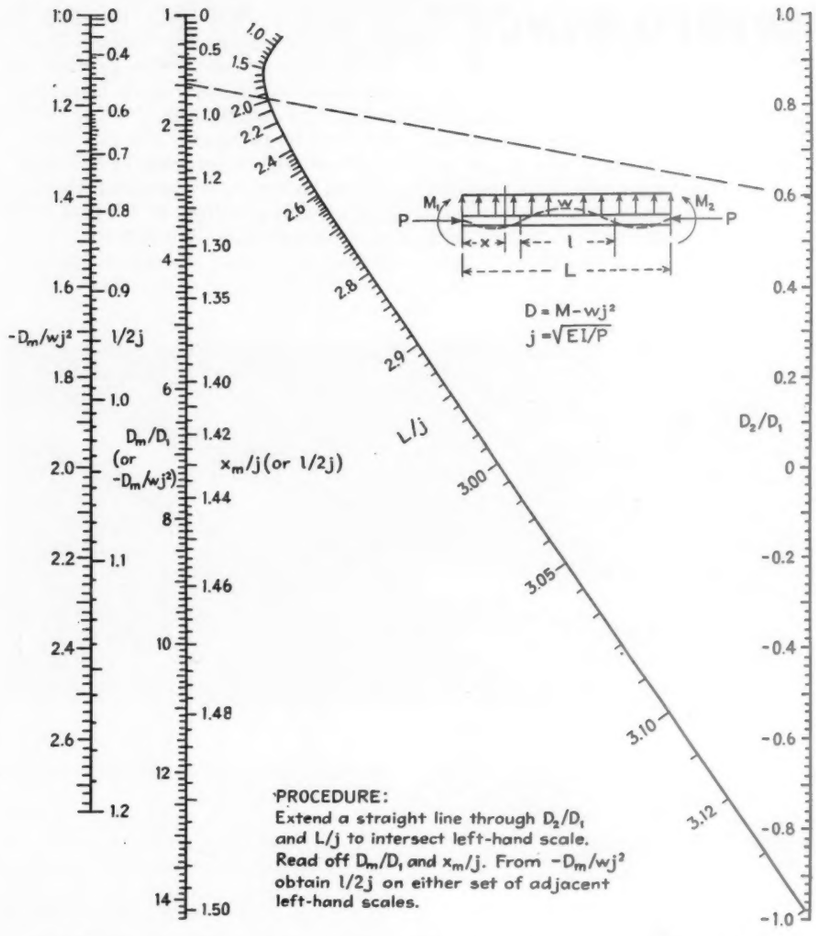


Fig. 1. Value and location of maximum moment and distance between points of inflection on beam-column under uniform side load.

A NOMOGRAM FOR BEAM-COLUMNS

A nomogram from which can be found the value and location of the maximum moment and the distance between points of inflection for a single-span beam-column subjected to a uniform side load.

By H. P. Liepmann *University of Cincinnati*

THE solution of the most common beam-column problem, that of a uniform side load, is well known.[1,2] Unfortunately, the solution usually given is not suitable for a quick preliminary analysis, which is highly desirable when the beam cross-section has to be determined by a cut-and-try process. For this reason, a nomogram which gives the value and location of the maximum moment and the distance between points of inflection for a beam-column under uniform side load, should be of interest to the airplane designer.

Maximum Moment

The notation used in the following development is the same as in references [1] and [2].

It will be convenient to employ the quantity

$$D = M - wj^2 \qquad (1)$$

rather than the actual bending moment. The well-known equation for the moment at any point of a span subjected to a uniform side load can be written in the form

$$D = [D_1 \sin(L - x)/j + D_2 \sin x/j]/\sin L/j \qquad (2)$$

in which $D_1 = M_1 - wj^2$ and $D_2 = M_2 - wj^2$ are the values of D at the left and right end of the span, respectively, and x is the distance measured from the left end. It is evident from Eq. (1) that M and D attain their maximum values at the same distance x. Hence, the distance x_m to the maximum moment is found by applying the condition $dD/dx = 0$ to Eq. 42), which yields

$$-\tan x_m/j = \cot L/j - (D_2/D_1) \csc L/j \qquad (3)$$

The introduction of Eq. (3) into Eq. (2) gives

$$D_m/D_1 = \sec x_m/j \qquad (4)$$

in which D_m is the maximum value of D. Then, the maximum moment M_m is found by substituting D_m in Eq. (1).

Distance Between Points of Inflection

Let l be the length of a pin-ended column. Due to symmetry, M_m, and also D_m, will occur at the mid-point of the column. Since $D_1 = -wj^2$ when $M_1 = 0$, Eq. (4) for this pin-ended column of length l reduces to

$$-D_m/wj^2 = \sec 1/2j \qquad (5)$$

Since $M = 0$ at the points of inflection the portion of a beam-column between those points is equivalent to a pin-ended beam-column. Hence, the distance l between the points of inflection of a beam-column can be found by substituting in Eq. (5) the value of D_m for the beam-column given in Eq. (4).

Nomogram

Fig. 1 shows a nomogram for the solution of Eqs. (3) and (4). Note that Eq. (3) is of the form

$$f_1(x_m/j) = g_2(L/j) - f_3(L/j)\, f_3(D_2/D_1) \qquad (6)$$

The x_m/j and D_2/D_1 curves for this nomogram will be straight lines, as in Fig. 1 when the L/j curve is defined by the parametric equation

$$x = abf_2/(bf_2 + c)\,;\; y = bcg_2/(bf_2 + c) \qquad (7)$$

where a is the distance in inches between the x_m/j and D_2/D_1 lines, b is the scale factor of the x_m/j curve and c the scale factor of the D_2/D_1 curve. Note that a, b and c can be chosen arbitrarily. For the nomogram in Fig. 1 the following values have been used: $a = 7$, $b = 0.7$ and $c = 5$.

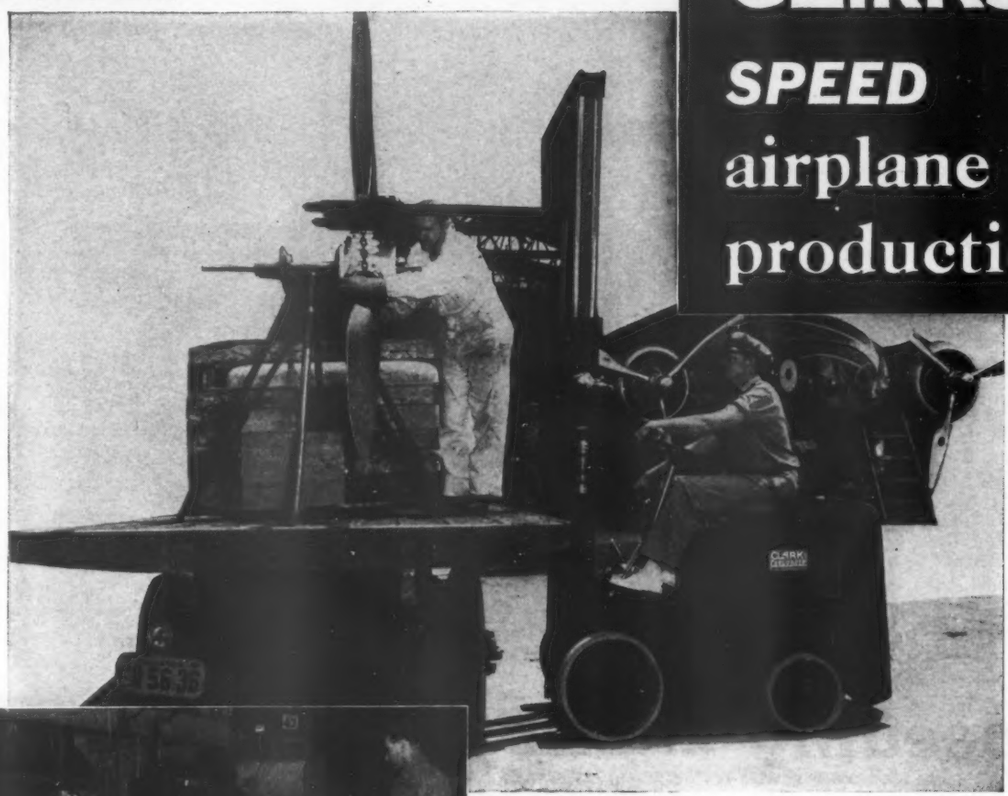
After a, b and c have been chosen the construction of the nomogram offers no difficulty. The size of the nomogram can be reduced by shifting the negative $x_m/j = 0$ and $D_2/D_1 = +1$ are on the same level (Fig. 1). Then the y values for the L/j curve have to be measured vertically from the straight line connecting the zero points on the x_m/j and D_2/D_1 scales, while the x-distances are measured horizontally from the x_m/j line.

The nomogram shown in Fig. 1 also

(*Turn to page 126*)

At the Lockheed plant, Burbank, Calif., "Clark" Fork Truck removes propeller assemblies from motor trucks, stores them safely, later spots them onto engine shafts in ships' wings. (Factory background in photograph "blacked out" by Army censors.)

CLARKS *SPEED* airplane production



Lockheed uses "Clark" 5-ton Die Handling Truck to retrieve die from storage and place it on drop hammer anvil. Note hydraulic ram and pusher bar sliding the die off the heavy truck fingers.

Wright Aeronautical Corp., Paterson, N. J., uses modern Clark "Utilitruck" for swift, safe handling of motors and other bulky, heavy loads, in storage and on the production line. They also act as portable working platforms for installation crews.

TWENTY-FOUR hour production schedules require machines capable of continuous operation. Clark Fork Trucks in a wide variety of models—capacities 2,000 to 7,000 lbs.—tiering heights 60 to 168 in.—are gas-powered and capable of 24-hr. uninterrupted service. They unload and store materials and parts. They lift, tilt, carry, tier at a swift, safe pace. Operating costs amazingly low.

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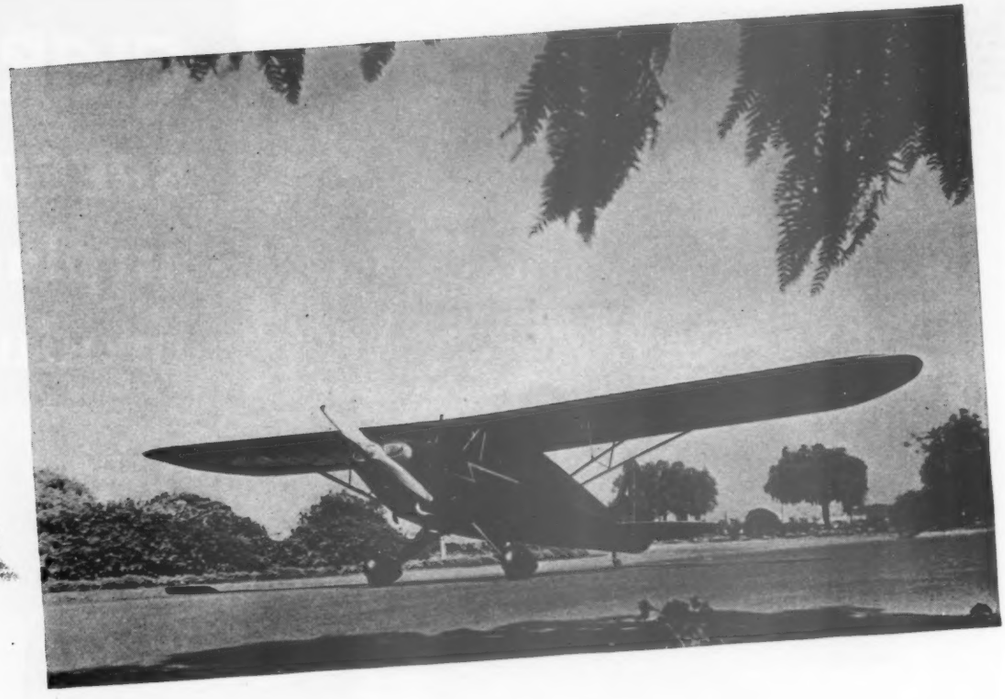


Speeding Lightplane Production

By W. E. Hirtensteiner, *Vice President in charge of Production, Interstate Aircraft & Engineering, Inc.*

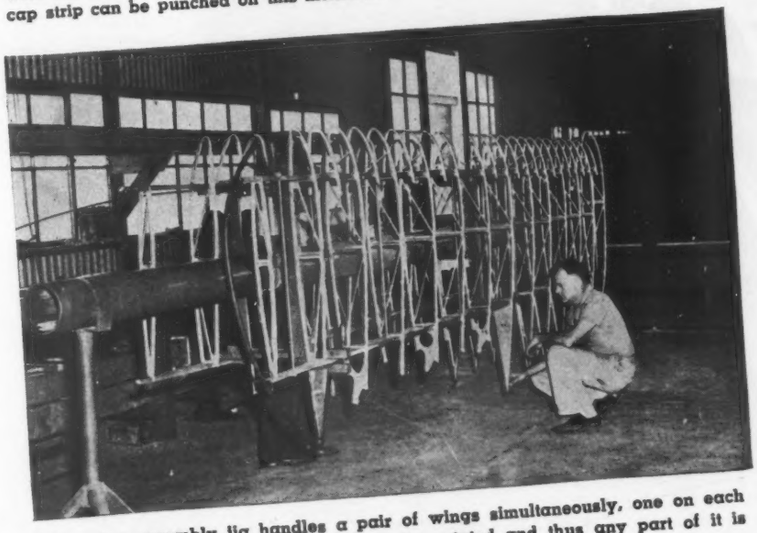
IN placing the Interstate Cadet lightplane trainer in production we have tried to provide the customer with more airplane for less money by making ingenious and "horse sense" applications of the best features of automotive and large aircraft production methods. A series of examples will serve to show how, by properly coordinating engineering with shop tooling, we have made the Cadet more rugged and serviceable, while making it easier to build faster, in less space, with fewer workmen. At this time of national emergency, with available factory space limited, and with experienced workmen heavily in demand, it is vitally important that we achieve the maximum economy of space and man-hours in our airplane production program. Incidentally, this also lowers overhead costs, which contributes, in the long run, to a better product at lower cost to the customer. Design of the Interstate Cadet is quite conventional, with a welded steel tube fuselage, strut-braced parasol monoplane wing with wood spars and metal ribs, and wire-braced tail surfaces. The entire airplane is fabric covered, except for the metal cowling forward of the cabin.

Our first major production economy resulted from development of a metal spring clip for attachment of the fabric. This results in a stronger and more satisfactory attachment than is possible by the conventional sewing method, and has been approved by the CAB. The use of these clips, in conjunction with a special rib design, very materially reduces the labor of attaching fabric to the plane, and produces a surface that is smooth and free from the thread humps left by rib stitching. The clips are simple pieces of formed wire which snap into place quite easily, drawing the fabric into a groove in the rib. Once in place the clips cannot be removed except by use of a special tool, as pulling on them only makes their grip more solid. The pinking tape used over each rib completely conceals and protects these clips from weathering.

In assembling the welded steel tube fuselage we have reduced man-hours required by many short cuts. All tube members are cut to length and proper angles for weld fit, through use of a special high-speed abrasive cutting machine. This one machine can precision cut all tubing required for ten or more airplanes daily.

All stressed tubing is 4130 chrome molybdenum, the welders are all certified to meet Army-Navy standards, and the welding rod is Oxweld No. 7, which is generally considered the highest quality available for such work. All welding work is subdivided so that assemblies are available to the maximum number of men simultaneously, and are fully accessible. For example, the fuselage is assembled in seven steps. There are separate welding fixtures for the cabin side frames, fuselage top frame, fuselage bottom frame aft of cabin, fuselage frame under cabin, and fin and tail post assembly. Each of these assemblies is welded in a rotatable jig of rigid, precision type, which is easily portable for convenient shop arrangement. Final operation is positioning of these various frames in the final assembly jig where precision fittings locate all parts for completion of the structure. This final

Left: the Interstate Cadet tandem trainer. Above: a rib-punching machine which perforates the cap strip in 34 places and performs two shearing operations, all with one movement of the foot treadle. Both cap strips, aileron ribs, and nose cap strip can be punched on this machine.



This wing assembly jig handles a pair of wings simultaneously, one on each side of the tubular frame. The jig can be rotated and thus any part of it is quickly accessible to the wing builders.

The Cadet fuselage is welded together from seven different subassemblies. The fuselage side frames for the forward portion are welded on this rotatable jig. The plywood panels shown here were used only during jig layout and were removed when production got under way.

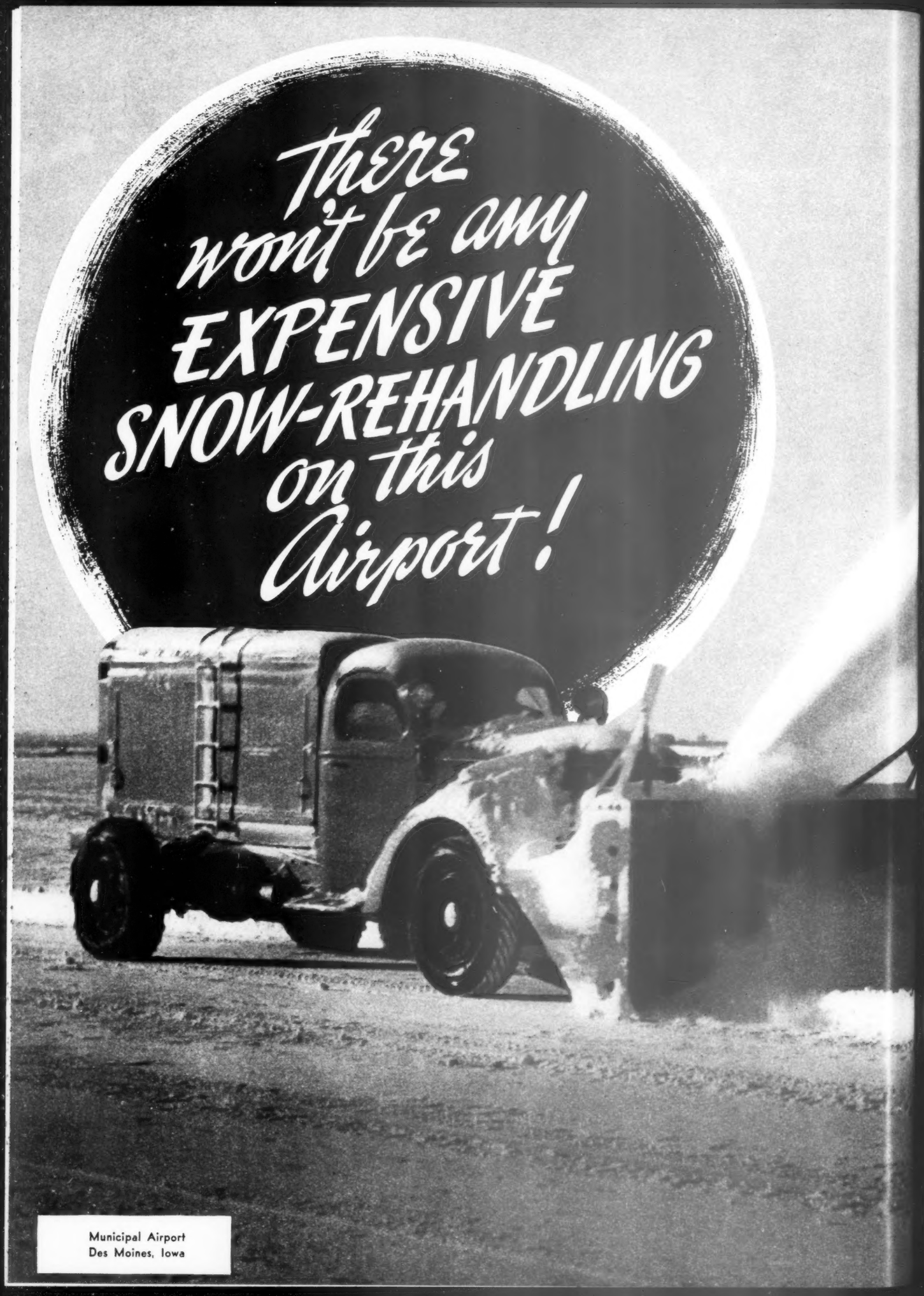
assembly fixture is also rotatable, being built around a heavy steel casing pivoted fore and aft. It will be obvious that, since the fuselage welding operation is subdivided into six preliminary operations and a final assembly operation, that at least eight welders can work simultaneously on a fuselage structure, with each having complete freedom of action. Also, this procedure greatly reduces the problem of misalignment due to weld shrinkage since this is taken care of in the preliminary frame welding operations and there is relatively little welding done in the final assembly fixture.

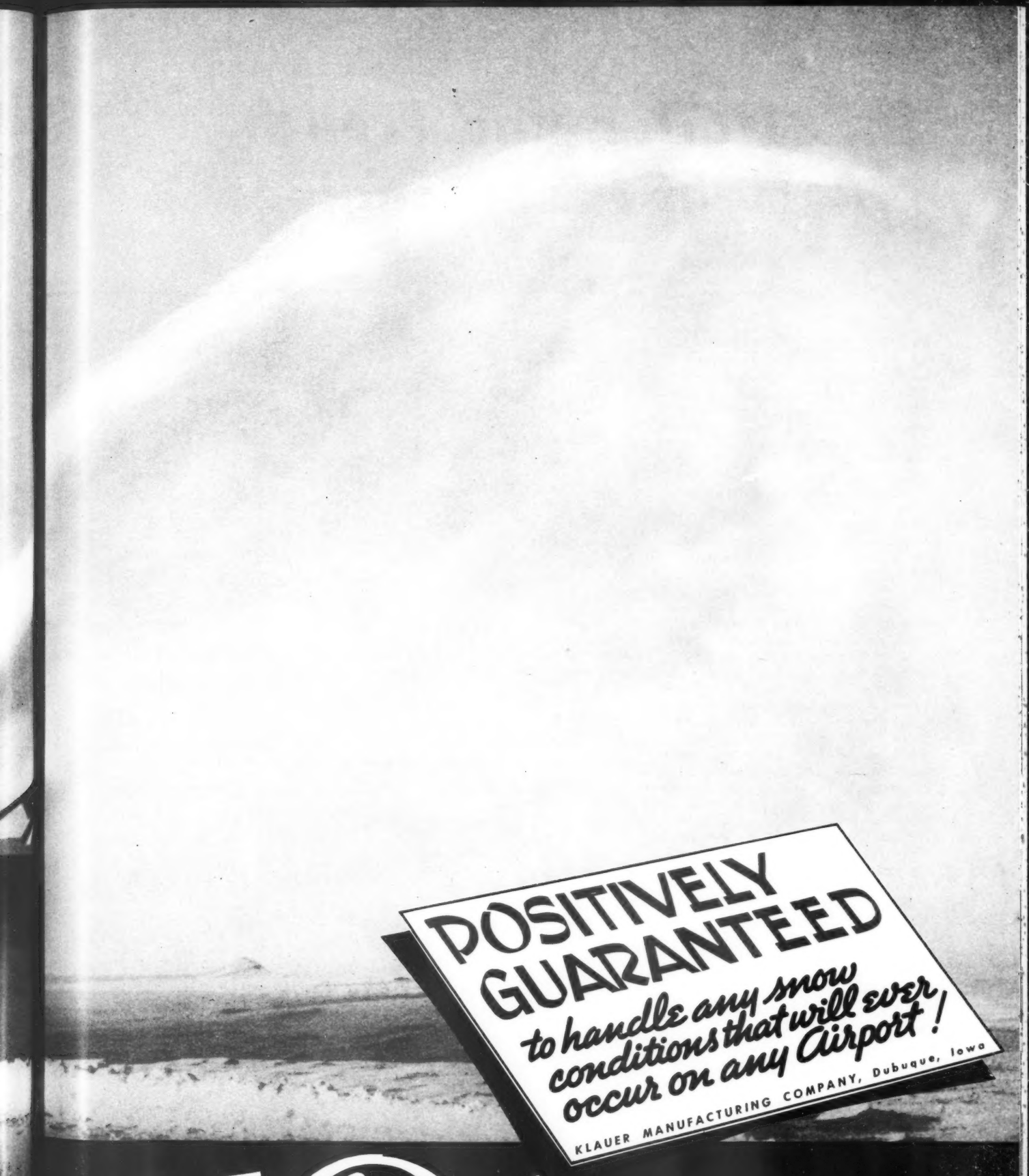
A further breakdown of the fuselage welding operation includes bench welding of numerous fittings and small subassemblies such as the tail wheel guide, tail wheel attachment, front seat bracket, fuel control bracket, tab control stop, lift strut attachments, rear stabilizer attachment tube, etc. These units are all assembled and welded in precision jigs with positive quick-acting clamps of cam type to hold the parts rigidly in place. Precision fixtures are used to locate all such units in the final assembly jig, or other jigs where they may be incorporated into the structure. An extremely simple clamp is used for holding all tubing in the various jigs. This clamp is a one-piece heavy spring steel wire device quite similar in action to a screen door hook. It is positive, easy to operate, rapid, and durable.

Another example of how highly developed are the welding fixtures, and at the same time how economically built, is the special turntable welding stand for

(*Turn to page 120*)

Interstate uses this power driven turntable for the welding of small circular parts. Turntable can be swung around to various positions. Power is from a motor driving through a friction disk and a phonograph turntable gear box, with speed controlled by a sewing machine speed-control treadle rheostat.


There won't be any EXPENSIVE SNOW-REHANDLING on this Airport!
Municipal Airport
Des Moines, Iowa



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THERE IS A SNOGO FOR EVERY BUDGET— FROM A 1½ TON TO THE LARGEST FOUR WHEEL DRIVE TYPE OF TRUCK

Italian and French Light Plane Engines

By Lucien Zacharoff

COMPAGNIA NAZIONALE AERONAUTICA of Rome, the owner and operator of the famous Littorio Airport where a factory is maintained for building experimental airplanes and engines, has developed a four-cylinder engine designed for sports and training craft. The new power plant consists of two rows of two opposing cylinders each; it is rated at 60 hp.

The four-cylinder CNAD joins the same concern's family of engines, among the best known of which are the six-cylinder in-line type of 150 hp. and a small two cylinder opposed-type of 38 hp. which weighs 42 kg. empty.

Consisting of two halves, the crankcase has its lower part inverted underneath for cooling. Including the general lubrication, the oil capacity is sufficient for 25 hours in the air. An oil pump in front is provided with pressure-regulating apparatus.

Cooling rib and duralumin heads are to be found on the cylinders, each of which has one inlet and exhaust valve operated from overhead. The valve bar is worked by a camshaft located above the oil well and operated by spur wheels which are actuated by the crankshaft.

Crankshaft plain bearing is lubricated by pressure feed. There are two vertical ignition devices at the rear of the engine.

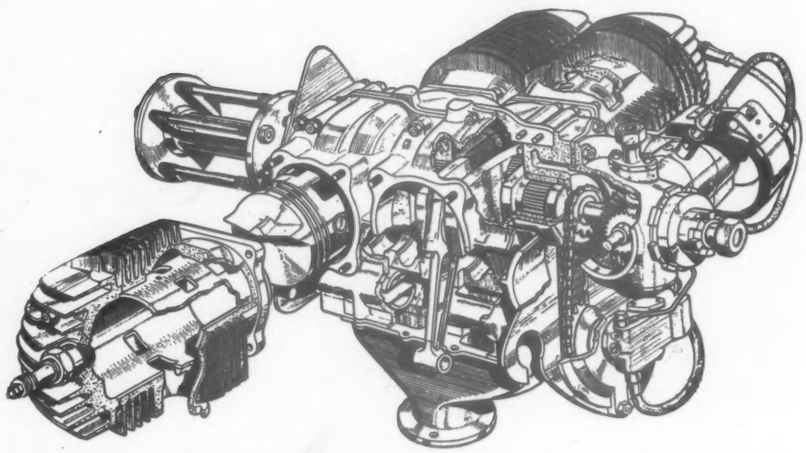
Carburetor connection is at the lowest part of the housing case. It is claimed that the carburation tube is satisfactorily warmed because it runs through the oil well.

All oil pipes are inside the crankcase. Additional specifications include:

Bore—100 mm.
Stroke—95 mm.
Displacement—2.98 liters
Compression ratio—1 to 5.3.
Rated output at 2,100 r.p.m.—60 hp.
Fuel consumption per hp.-hr.—255 g.
Oil consumption per hp.-hr.—1.5 g.
Empty weight—82 kg.

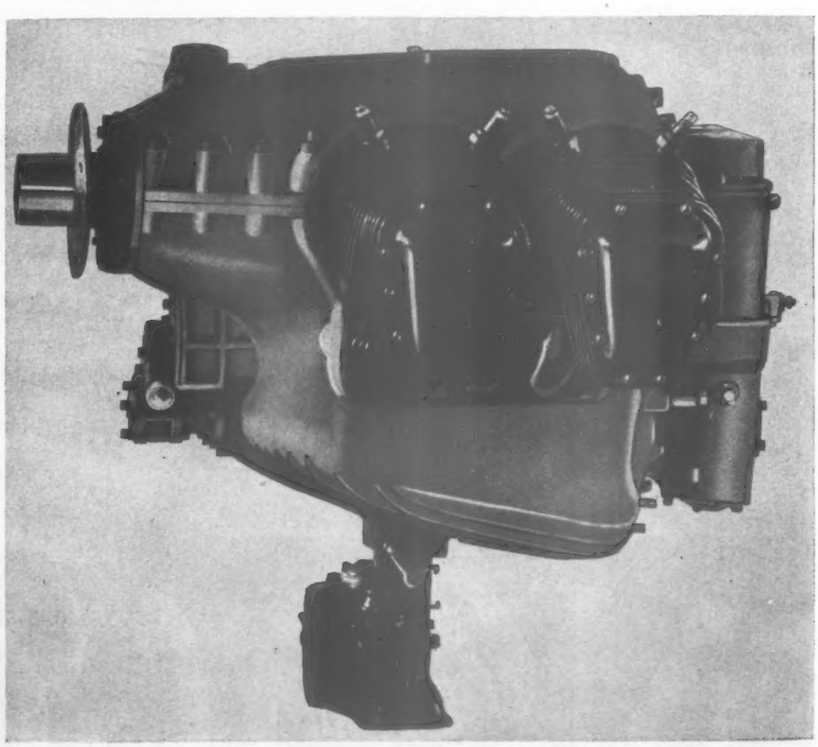
News of another European engine for light planes reached this writer about the time of the collapse of France. Although the two-stroke AVA 4 A-00 received publicity before the outbreak of hostilities as one of a crop of light-plane engines produced by L'Agence

(*Turn to page 122*)

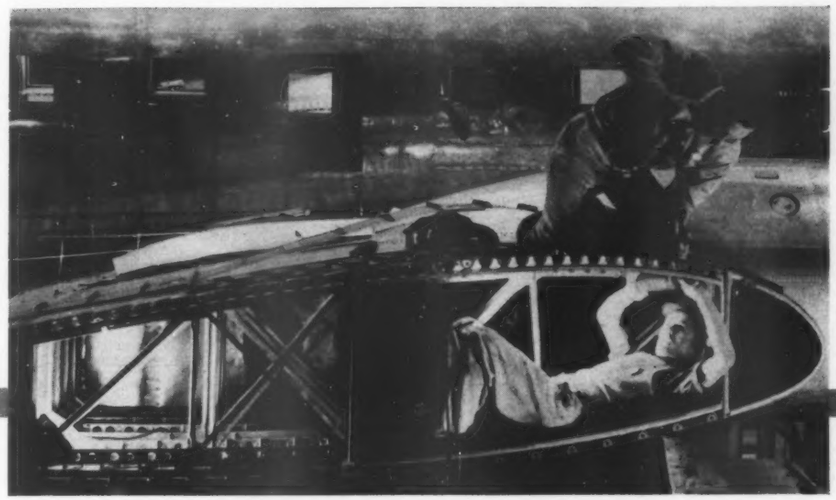


Above: the French AVA 4 A-00 is a two-stroke engine developing 25 hp. and used in the Gaucher. Drawing by J. Gaudefroy for L'Aeronautique.

Below: the four-cylinder Italian 60 hp. CNAD engine for light planes. A novel feature is the cooling area at the bottom of the engine.



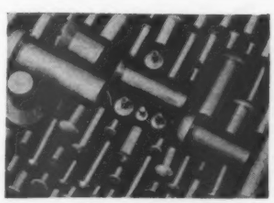
Know-How IS A *Vital Resource* TOO!



The worker, placing the rivets in a wing structure, finds them sound and easy to drive.

Take, for example, aircraft rivets made from Alcoa Aluminum Alloys.

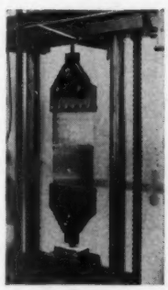
Riveted joints look so simple. But to attain the quality now considered requisite, these three actions had to be completed: first, metallurgists and engineers developed the fine-grained material which permits neater and more satisfactory joints to be made; then uniform production technique was evolved to maintain its desirable characteristics; finally, convenient procedures were worked out for actual assembly operations.



Some of the many types of Alcoa Aluminum rivets made for aircraft construction.

Developing this *know-how* required months and years. The aircraft industry has this indispensable knowledge, and uses it.

We have the know-how because the men who build planes, and the men who make Alcoa Aluminum Alloys, worked together to learn. And this process, of developing and disseminating technical knowledge, is part of the regular process of making Alcoa Aluminum for aircraft production, as well as a contribution to the readiness for mass production of aircraft. ALUMINUM COMPANY OF AMERICA, 2182 Gulf Bldg., Pittsburgh, Penna.



Experiments at Aluminum Research Laboratories lead to sounder, stronger, riveted joints; constant testing assures quality of rivets.

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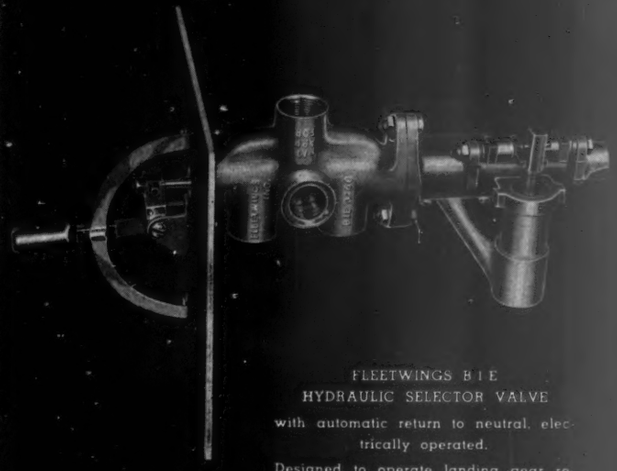

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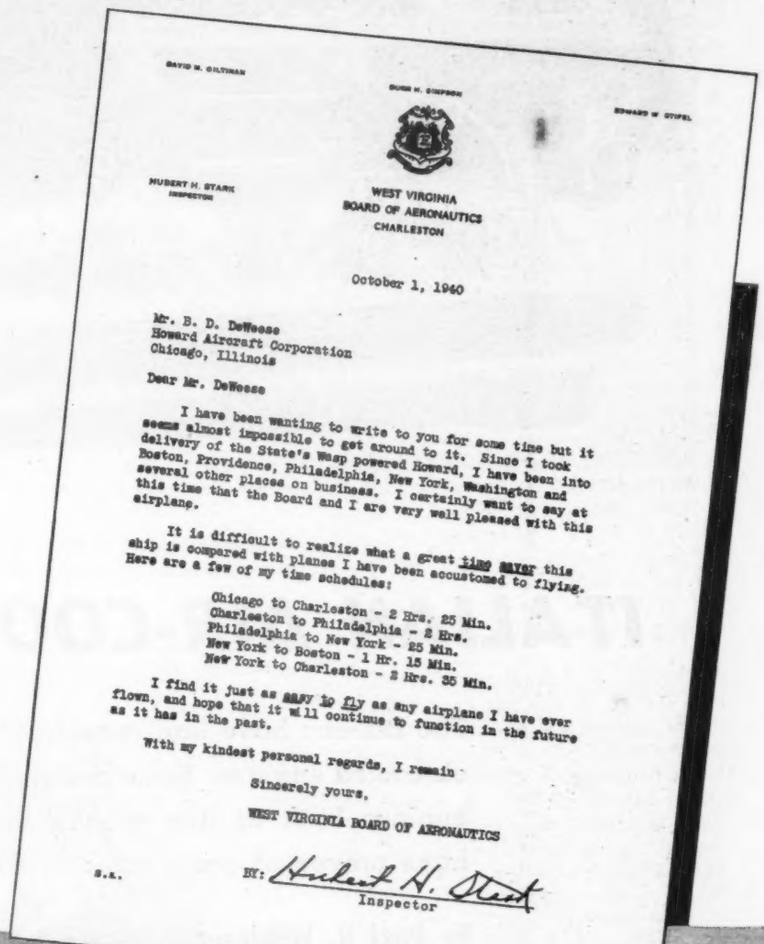

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INSPECTOR

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BOARD OF AERONAUTICS
CHARLESTON

October 1, 1940

Mr. B. D. DeWeese
Howard Aircraft Corporation
Chicago, Illinois

Dear Mr. DeWeese

I have been wanting to write to you for some time but it seems almost impossible to get around to it. Since I took delivery of the State's Wasp powered Howard, I have been into Boston, Providence, Philadelphia, New York, Washington and several other places on business. I certainly want to say at this time that the Board and I are very well pleased with this airplane.

It is difficult to realize what a great time saver this ship is compared with planes I have been accustomed to flying. Here are a few of my time schedules:

Chicago to Charleston - 2 Hrs. 25 Min.
Charleston to Philadelphia - 2 Hrs.
Philadelphia to New York - 25 Min.
New York to Boston - 1 Hr. 15 Min.
New York to Charleston - 3 Hrs. 35 Min.

I find it just as easy to fly as any airplane I have ever flown, and hope that it will continue to function in the future as it has in the past.

With my kindest personal regards, I remain

Sincerely yours,

WEST VIRGINIA BOARD OF AERONAUTICS

S.A. BY: Hubert H. Stark
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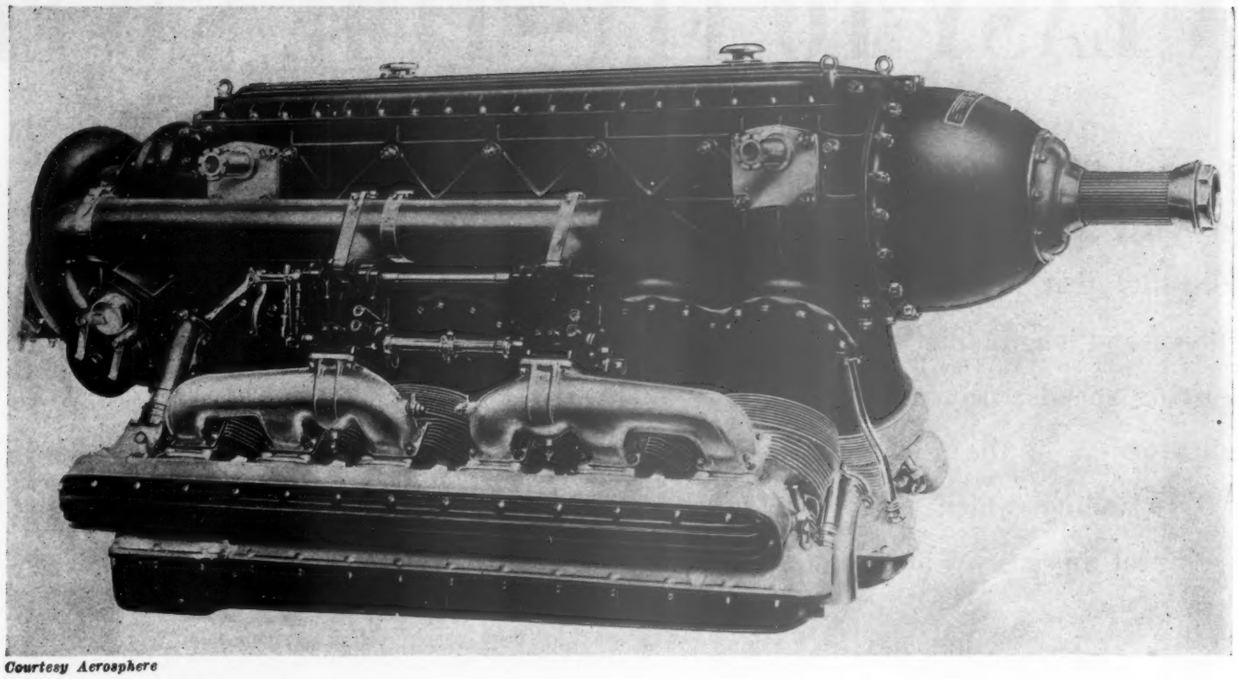


Courtesy Aerosphere

ITALIAN AIR-COOLED ENGINES

The Italians have had considerable success in building air-cooled engines. Some designs have been based upon engines built in this country, but in any event they have proven of great value in their military campaigns

By Paul H. Wilkinson *Consultant, Diesel Aviation*

IN Italy, air-cooling is now used extensively for high-powered military aircraft engines. Although water-cooled engines of the V and W types with twelve and eighteen cylinders were much in evidence two or three years ago the present trend is toward air-cooled engines such as one-row and two-row radials and inverted-vee type engines. Undoubtedly this trend has been influenced to a great extent by climatic conditions in the Mediterranean and North Africa where difficulties often are encountered in obtaining cooling water.

Isotta Fraschini Engine

Four well-known aircraft engine manufacturers are building air-cooled engines for military purposes. Perhaps the most striking development is the new Isotta Fraschini Delta RC 35 IDS engine which has twelve cylinders arranged in two inverted banks below the crankcase. The angle between the cylinder banks is 60 deg. and this reduces the frontal area to 7.3 sq.ft. and permits excellent streamlining for high-performance aircraft. This particular model is equipped with four Isotta Fraschini carburetors and a one-speed gear-driven supercharger. It can be fitted with a hollow propeller shaft to accommodate a 20 mm. shell gun. This engine is shown in above photograph.

The performance of the Delta is good and it develops 770 hp. at 2,600 r.p.m. for take-off. It is rated at 750 hp. at the same crankshaft speed at an altitude of 11,500 ft. when running on 87-octane

SPECIFICATIONS

Isotta Fraschini Delta RC 35 IDS Aircraft Engine

Type: twelve cylinders, air-cooled, 60 deg. inverted vee, geared drive, four-cycle
Bore and stroke: 5.20x6.30 in.
Displacement: 1,605 cu.in.
Length and area: 78.8 in.x7.3 sq.ft.
Rated output: 770 hp. for take off
750 hp. at 11,500 ft.
Total weight (dry): 1,120 lb.
Specific weight: 1.45 lb./hp.
Fuel consumption: 0.48 lb./hp./hr.
Oil consumption: 0.22 lb./hp./hr.
Compression ratio: 6.4 : 1

gasoline. As it weighs 1,120 lb., its specific weight is 1.45 lb. per hp. A more powerful engine of the same type is now under development and is equipped with a two-speed supercharger and has a rating of approximately 1,200 hp. at high altitudes. The type of warplane in which these engines are used is a military secret.

The Alfa Romeo

In the field of the air-cooled radial, three manufacturers produce engines of approximately 1,500 hp. Alfa Romeo acquired licenses for the Bristol Mercury and Pegasus engines from Great Britain in 1931 and after gaining experience with them has developed some excellent engines of its own. The most powerful engine in production is the Alfa 135 RC 34 model which has eighteen cylinders in two banks and a one-speed gear-driven supercharger. This engine is rated at 1,500 hp. at 2,400 r.p.m. for take-off and delivers 1,400 hp. at 2,400 r.p.m. at an altitude of 11,200 ft. It weighs 2,105 lb., or 1.40 lb. per hp.

Equipment on the Alfa 135 RC 34 engine comprises a Zenith downdraft carburetor with automatic boost control and mixture control, two Marelli eighteen-cylinder magnetos and a Garelli compressed gas starter with engine-driven distributor. A smaller engine known as the 126 RC 32 model and developing 750 hp. is used in Savoia-Marchetti SM 79 three-engined bombers.

Fiat radials are manufactured in various sizes and power outputs. The Fiat A 82 RC 42 is the largest production engine and has eighteen cylinders and runs on 87-octane gasoline. The displacement of this engine is 2,873 cu.in. and it is rated at 1,400 hp. at 2,400 r.p.m. for take-off and 1,250 hp. at 2,300 r.p.m. at an altitude of 13,800 ft. Its one-speed supercharger is geared at 7 : 1 and its propeller drive is geared at 1.6 : 1. It weighs 1,910 lb. which is equivalent to a specific weight of 1.36 lb. per hp. Like other Italian aircraft engines, it is equipped with a Garelli compressed gas starter.

Fiat A 80 RC 41

A slightly smaller model known as the Fiat A 80 RC 41 develops 1,000 hp. This engine is used in Breda 65 two-place fighters, Breda 82 two-engined bombers and Fiat BR 20 two-engined bombers. The 850 hp. Fiat A 74 RC 38 model is used in Fiat G 50 one-place interceptors which have a ceiling of 35,000 ft., and Macchi C 200 one-place interceptors which can climb to an altitude of 20,000 ft. in 6½ minutes and have a ceiling of 34,000 ft. Fiat air-cooled radials have an excellent reputation and have established numerous aviation records.

The Piaggio Radial

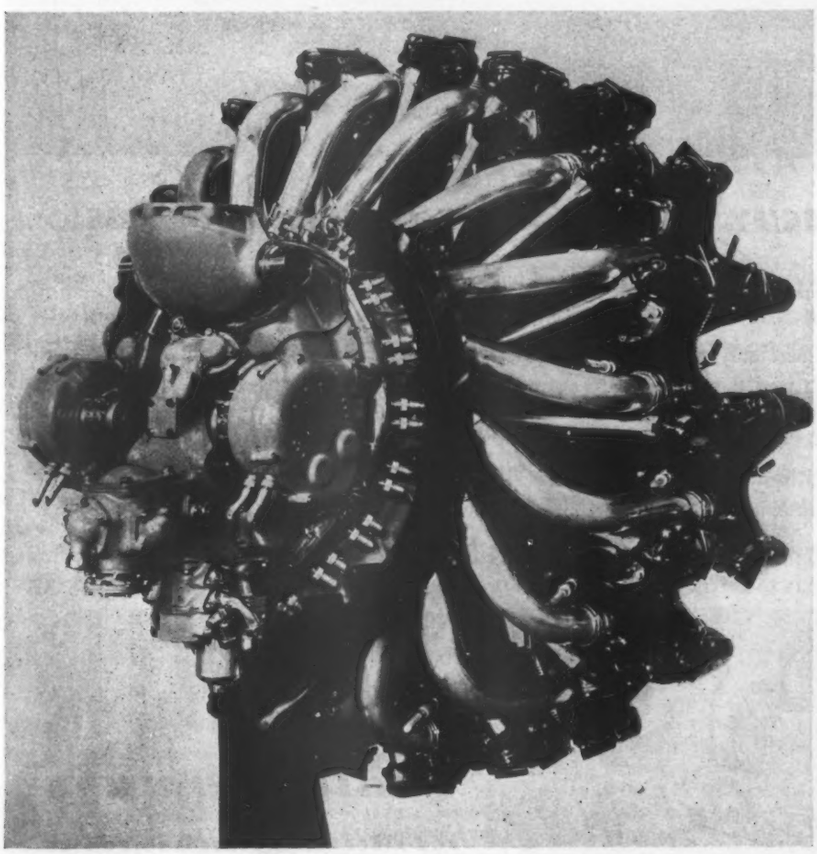
The most powerful radial manufactured by Piaggio is a two-row engine with eighteen cylinders. This engine is known as the Piaggio P XII RC 35 model and is rated at 1,500 hp. at 2,100 r.p.m. for take-off and delivers 1,300 hp. at 2,000 r.p.m. at an altitude of 11,500 ft. When running on 87-octane gasoline it has a consumption of 0.46 lb. per hp. per hour. Its weight is 1,875 lb., or 1.25 lb. per hp. Its compression ratio is 6.5 : 1.

The 1,500 hp. Piaggio P XII RC 35 engine powers the new Piaggio P 108 four-engined long-range bomber which is now in production. A slightly smaller engine known as the P XI RC 40 model and developing 1,000 hp. is used in the Caproni Ca 135 bis two-engined bomber, the Piaggio P 32 two-engined bomber, and the Breda 88 two-engined bomber which has a maximum speed of 321 m.p.h. and a ceiling of 28,000 ft.

In addition to the engines listed, the firms of Alfa Romeo, Fiat and Piaggio are developing two-row radials of approximately 2,000 hp. which should be in production at an early date.

Three-quarter front view of the 770 hp. Isotta Fraschini Delta RC 35 IDS twelve-cylinder air-cooled engine. Its low frontal area makes it an attractive power plant for high-performance aircraft. Opposite page.

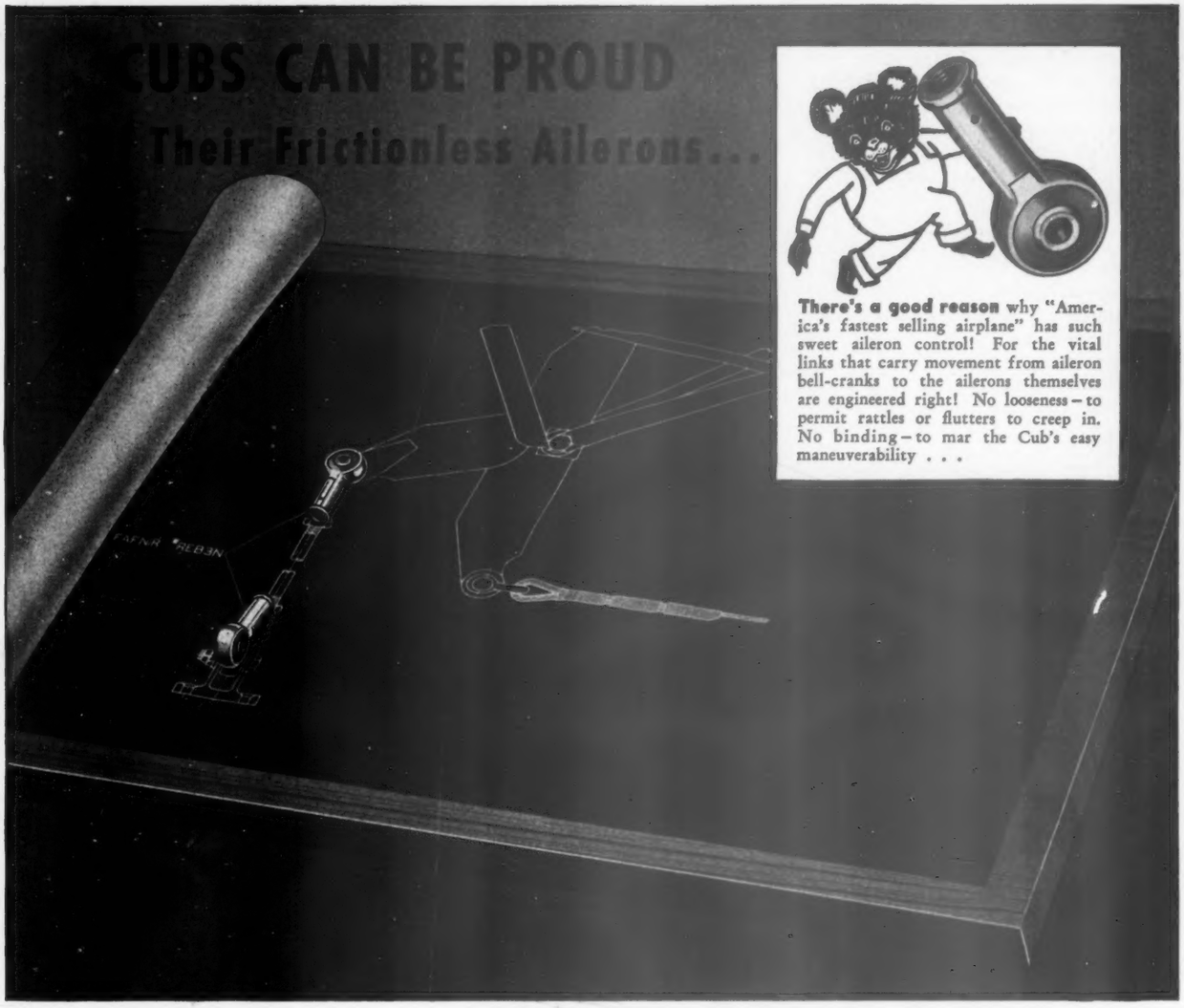
Rear view of the 1,400 hp. Fiat A 82 RC 42 eighteen-cylinder radial which has been developed for Italy's warplanes. Note the neat arrangement of the accessories surrounding the one-speed gear-driven supercharger. Below.



SPECIFICATIONS

Fiat A 82 RC 42
Aircraft Engine

Type: eighteen cylinders, air-cooled, two-row radial, geared drive, four cycle
Bore and stroke: 5.60x6.50 in.
Displacement: 2,873 cu.in.
Diameter and area: 52.7 in.x15.1 sq.ft.
Rated output: 1,400 hp. for take-off
1,250 hp. at 13,800 ft.
Total weight (dry): 1,910 lb.
Specific weight: 1.3 lb./hp.
Fuel consumption: 0.45 lb./hp./hr.
Oil consumption: 0.22 lb./hp./hr.
Compression ratio: 6.7 : 1



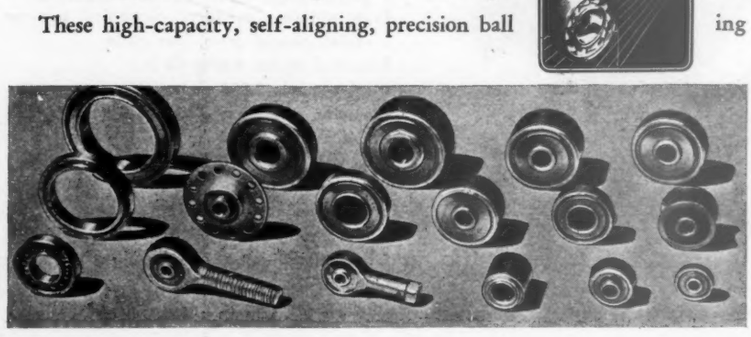
There's a good reason why "America's fastest selling airplane" has such sweet aileron control! For the vital links that carry movement from aileron bell-cranks to the ailerons themselves are engineered right! No looseness – to permit rattles or flutters to creep in. No binding – to mar the Cub's easy maneuverability . . .

PIPER ENGINEERS SPECIFY FAFNIRS RIGHT ON THE DRAWINGS!

"Quality – at a price" is the policy that is selling thousands of Piper Cubs; and for proof that this policy is followed to the smallest detail, you have only to look at this blue print of the Cub aileron link assembly.

Piper engineers both friction and looseness out of vital aileron links – and does it easily, by specifying Fafnir REB3N Rod Ends, right on the drawings. These high-capacity, self-aligning, precision ball bearing units mean more than easy and uniform assembly, more than sensitive, friction-free aileron control.

These Fafnirs mean that every Cub will *stay* sensitive and friction-free at these control points, without constant adjustments to take up wear. For the same benefits in any part of your engine or flying controls, specify "Fafnir," right on the drawings. The Fafnir Bearing Co., Aircraft Division, New Britain, Conn.



FAFNIR
Ball Bearings

FOR AIRCRAFT ENGINES AND CONTROLS

Be Ready FOR WINTER'S COMING BLOCKADE!

EQUIP NOW with FWD'S

FOR FAST...LOW-COST AIRPORT SNOW CLEARING

It's high time to get prepared for winter's coming blockade—to guard against the winter menace of snowbound runways.

Many airports in the snow belt are now equipping their FWD's — busy all summer on regular maintenance work — with rotary and other types of snowplows to be ready to combat *snow*, the enemy of winter air travel and transportation.

FWD is the preferred truck for fast, low-cost snow removal, because it has the full power of four driving wheels — the ability to smash its way through the deepest drifts — do a clean job faster — and still be thrifty with operating costs.

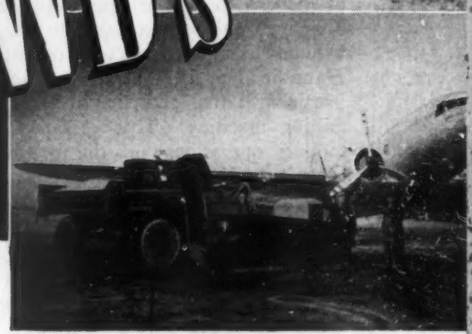
The use of special heat-treated steels developed to provide the maximum of resistance against failure in sub-zero temperatures — special gear ratios, proper snowplow mounting facilities, ample reserve power and balanced traction of four driving wheels — definitely distinguish the FWD from the ordinary trucks, frequently commandeered for the emergency, in snow removal service.

Write for the FWD performance record on airport snow removal and other maintenance service.

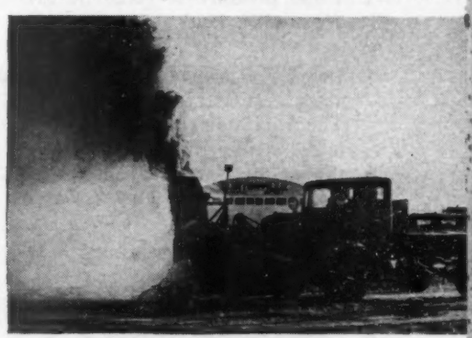
FWD TRUCKS

FWD trucks are built in sizes ranging from 1½ to 25 tons capacity in both four-wheel and six-wheel drive, with engines from 85 to 200 horsepower, gasoline or diesel powered. Special gear ratios for rotary snow operation are incorporated into the standard FWD truck producing a gear ratio from 200 to 600 to 1 in low range and with road speeds of from 45 to 75 miles per hour for high-speed operation. Sales and service facilities are available from coast to coast and in all principal countries overseas.

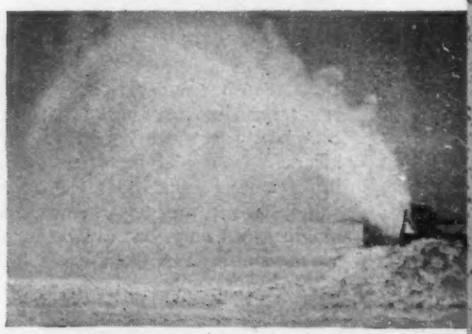
THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis., U.S.A.
Canadian Factory: **KITCHENER, ONTARIO**



Many of the leading airports in the United States a Canada find FWD trucks indispensable—equipment that seldom idle and yielding a full return on the investme



More FWD trucks are used in snow removal—airports a highways — than any other make of truck or tractor.



Prompt dispatch of planes from this Municipal Airport go on through the winter as well as summer with this FW rotary keeping runways clear.

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

Three modernized reversible air-driven wrenches widely applicable to aircraft assembly operations have been introduced by the Chicago Pneumatic Tool Co. With bolt size capacity of $\frac{3}{8}$ in., $\frac{5}{8}$ in., and $\frac{3}{4}$ in. respectively, the new power wrenches all employ a slow-speed power-vane type rotary motor and feature no gears and a springless driving unit.—AVIATION, *November, 1940.*

Indicative of the rapid progress being made in the application of hydraulic systems to aircraft is the new engine-driven, gear type hydraulic pump developed by the Pump Engineering Service Corp., Cleveland, Ohio, for operation of wing flaps, landing gear and other high-pressure hydraulically operated units. The pump has a displacement of 0.7 cu.in. per revolution and is capable of more than 400 r.p.m. with pressures up to 1,500 lb. per sq.in. The pump is recommended for high-speed operation since volumetric efficiency falls off rapidly at speeds below 2,000 r.p.m. When furnished with a female coupling the pump can be used as a hydraulic motor for operating a fuel pump or other unit at a station remote from the engine.—AVIATION, *November, 1940.*

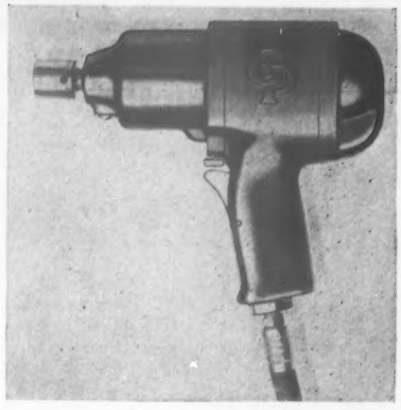
The rush for aircraft production has not permitted us to forget the importance of modern tool-room equipment, for tooling is the heart of all production planning. A unique and valuable machine for all-around tool room work, and for use on limited production operations when not otherwise used, is the new Hannifin No. 10 tool room machine which combines in one compact unit a precision lathe, sensitive drill press, horizontal milling machine and vertical milling machine. This versatile machine makes it possible to complete many tooling operations on the one machine, saving time and increasing work capacity. The machine, a product of the Hannifin Manufacturing Co., Chicago, Ill., can also be arranged for screw cutting work.—AVIATION, *November, 1940.*

The Morris Speed Clamp, developed by the Morris Engineering Co. of Los Angeles, and used by a number of West Coast concerns for holding sheet metal parts to jigs. The screw is in two parts, the inner screw and an outer sleeve. Both the sleeve and the threaded portion of the clamp frame have interrupted threads. Thus the entire screw section may be pushed quickly through the frame, then the sleeve is given a $\frac{1}{4}$ turn to the right which locks it in position. Final pressure is given by giving the inner screw a slight turn.—AVIATION, *November, 1940.*

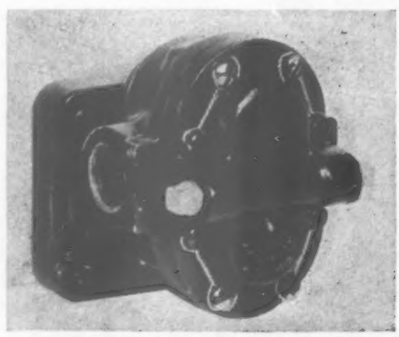
Developed primarily for deep drawing fuel tanks and other similar parts for the aircraft industry, a 650-ton triple-action blankholder press has been introduced by The Hydraulic Press Manufacturing Co., Mt. Gilead, Ohio. A 100 hp. electric motor drives the press at 260 ft. per min. closing and opening speeds, and 45 ft. per min. pressing speed. Numerous advanced features are incorporated in the design.—AVIATION, *November, 1940.*

Seven tons of streamlined beauty is the descriptive phrase used by Kearney & Trecker Co., Milwaukee, Wis., in describing their newest series of heavy-duty vertical milling machines. Incorporating every up-to-the-minute improvement resulting from many years of successful machine tool building, the machine should prove popular for heavy aircraft and aircraft engine machine work. Working surface of the table is 82x18 in., 24 speeds in geometrical progression from 13 to 1,300 r.p.m. are provided for the working unit, while 32 feeds of $\frac{1}{4}$ in. to 60 in. per minute both longitudinal and cross, and $\frac{1}{8}$ in. to 30 in. vertical are provided for the table.—AVIATION, *November, 1940.*

Developed particularly for production service on small parts requiring polishing, countersinking, reaming, burring, and filing, a small speed lathe introduced by the Standard Electrical Tool Co., Cincinnati, Ohio, should find wide application in aircraft shops and factories. Outstanding feature of the unit is a clutch and brake arrangement, operated by a foot pedal, which permits stopping the work spindle while the motor continues to operate. The machine is available in a single speed only, but can be furnished in any speed required from 150 to 3450 r.p.m., and in sizes from $\frac{1}{2}$ to 2 hp.—AVIATION, *November, 1940.*



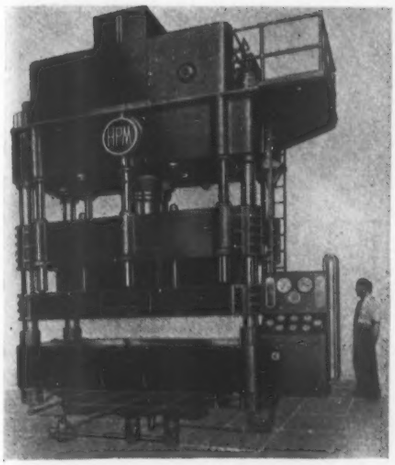
Pneumatic air-driven reversible wrench



High-speed gear type hydraulic pump

Hannifin No. 10 tool-room machine

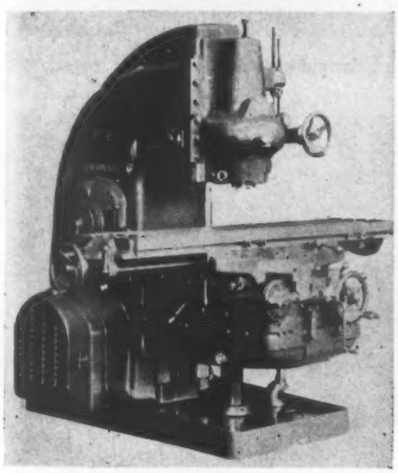
The Morris Speed Clamp



HPM triple-action blankholder press

Although aircraft production men shy away from single-purpose automatic production machinery, there is a big field for automatic machinery of the flexible type that can be adapted to many different operations with a minimum of change-over time. Such a machine is the low-cost duplicator developed by Detroit Universal Duplicator Co., Detroit, Mich. Savings of more than 80 percent are claimed for this machine as compared with work previously done on a standard milling machine. Utilizing a shaper, a template, and a tracing finger and controlling head to transfer the work outline to the shaper tool, the machine is adaptable to a wide variety of operations.—AVIATION, *November, 1940.*

A new way of getting light around corners, of special interest to tool and die makers, lathe and screw machine operators, inspectors, etc., is the Ang-Lite offered by the Diagnostic Ultra-Lite Co., New York, N. Y. Fabricated from DuPont Lucite, which has the peculiar ability of carrying light around corners, the Ang-Lites are made up in various stock shapes and designs calculated to get light into all sorts of inaccessible places. The light source is a specially designed Eveready pocket pen lite with a telescopic metal sleeve which shields the light source and contains interchangeable reducing bushings into which are screwed the large selection of special Ang-Lites.—AVIATION, *November, 1940.*

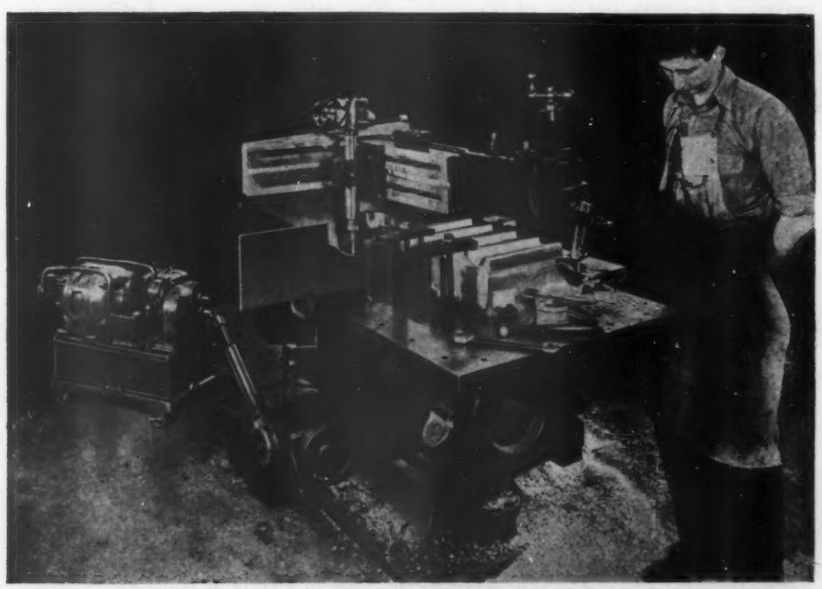


Vertical milling machine

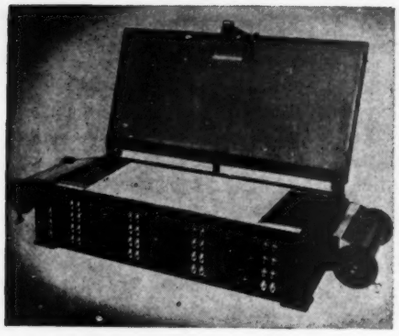
With aircraft factory construction under way on every hand the problem of moving stock, supplies, and equipment is a vital one, as manufacturers struggle to keep production going during construction of plant additions. In this connection it is important to pay particular attention to the "rigging" employed in shifting parts and equipment, since it is important that this work be done quickly, efficiently, and without damage to plant or parts. To meet the need for modern block and tackle equipment, the Federal Alloy Block Co., Cincinnati, Ohio, has developed a line of blocks available in aluminum alloys, cast steel, malleable iron, brass, bronze, rubber, bakelite, fiber, glass, or other materials, and suitable for use with Manila or wire rope. Greater safety, lifting capacity, and efficiency, coupled with low maintenance cost, are the result of the century of experience in the design and manufacture of improved blocks for all industrial applications.—AVIATION, *November, 1940.*

An advanced design RF relay particularly suited for low power radio transmitters such as are used in aircraft, has been developed by the Leach Relay Company, Los Angeles, which specializes in electric relays for aircraft installations. This new relay has glazed #196 AlSiMag insulation, pure silver contacts, and heat-treated nickel-plated beryllium copper pole pieces.—AVIATION, *November, 1940.*

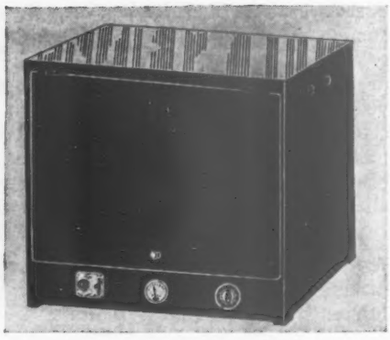
Speed lathe



Detroit Universal Duplicator



Aerial roll film printer



Engine cylinder baking oven

Taking advantage of new developments in lighting, the Fairchild Aviation Corp., Jamaica, L. I., has designed an improved type of aerial roll film contact printer designated Model F 58. Equipped with a large number of small low-wattage Argon glow lamps, the new printer features lower electric power consumption, very even light distribution, faster printing, and longer service life. Because of their low wattage the Argon lights generate very little heat and it is unnecessary to provide any special means of forced ventilation for the printer, such as a blower, even when operated continuously for long periods. This feature has made it possible to reduce the size and weight of the printer materially. Sizes available for roll film printing are for negatives up to 9x9 in. or for negatives 9x18 in. Another model is made for printing large copy negatives up to 20x24 in. in size.—AVIATION, *November, 1940.*

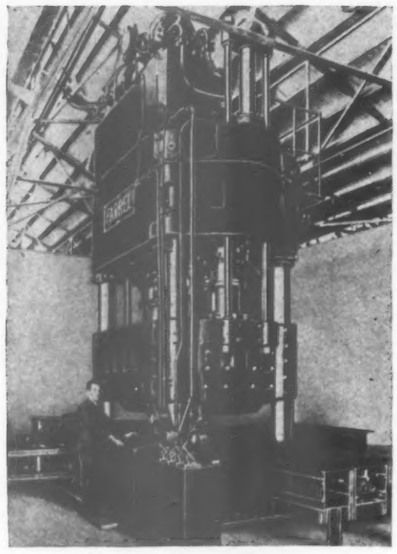
Featuring high heat obtained with low wattage, a new electric oven designed specifically for quick baking enamel on aircraft cylinders and similar parts has been developed by the Aeronautical Trading Co., Floyd Bennett Airport, Brooklyn, N. Y. Heated by an element mounted directly in the bottom center of the baking oven, a temperature of 450 to 500 deg. F. can be maintained. Inside size is 18x17x24 in. Effective insulation is provided. A temperature gage with a range of zero to 500 deg. F. is mounted.—AVIATION, *November, 1940.*

With the increasing volume of production of metal aircraft parts the hydraulic press has come into its own. Improvements and refinements to existing presses have steadily widened the scope of such equipment for aircraft work. Latest hydraulic press to come to our attention is the 2,200-ton model being built by the Farrell-Birmingham Co., Inc., of Ansonia, Conn. Four loading and unloading tables are incorporated in the press construction, and these tables are equipped with movable platens controlled from the main control desk, for carrying dies into and out of the press. The entire operation of the press is is effected from a single control station located near a corner of the press, and consists of a set of simple pushbuttons. Dimensions of the clear space available between tie rods are 61 in. wide and 97 in. long.—AVIATION, *November, 1940.*

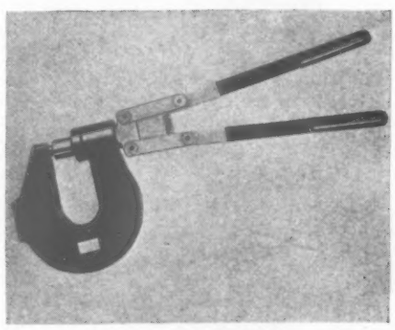
Model 420 Riveter, manufactured by Knu-Vise, Inc. of Detroit, Michigan, promises to be of great help in airplane production. It weighs only 20 lb., is 20 inches long and can obtain a pressure of 10,000 lb. There is a detachable yoke with a threaded adjustment and has an easily removable tool steel plunger. The size of the yoke is .. inches wide and 4 inches deep.—AVIATION, *November, 1940.*

Low-cost maintenance of clear runways on airports which experience a weed and brush problem is made possible by the Bishop high-speed power mower developed by the Bishop Rotary Mower Co., Arcadia, Fla. This machine is built around a Ford V-8 commercial chassis. Mower mechanism is protected against damage by rocks or heavy sticks. The machine cuts a swath 7 ft. wide and operates from 8 to 20 miles per hour. Experience has shown that the machine will cut ordinary brush up to 1 in. in thickness. A number of such machines are already in use for airport maintenance.—AVIATION, *May, 1940.*

Combining a printer and dry-developing unit built into a single compact machine, a medium priced whiteprint machine has been announced by the Ozalid Corp., Johnson City, N. Y. Known as the Model "F" this machine incorporates numerous advanced features including reduction of electrical consumption more than 50 percent over other machines of similar capacity. Ozalid sensitized



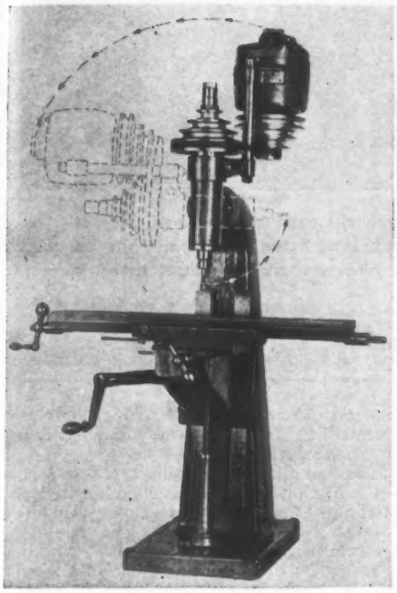
Farrel-Birmingham hydraulic press



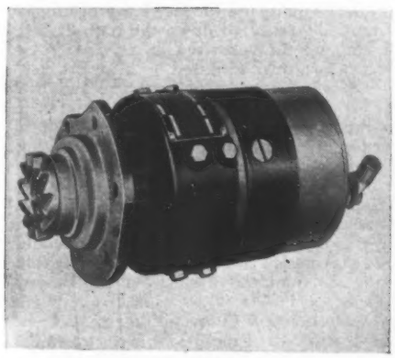
Knu-Vise Riveter

Bishop Ford V-8 mower

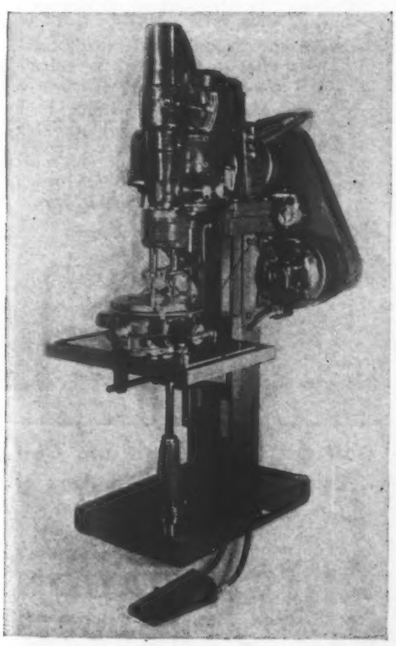
Olalid Model "F" whiteprint machine



Univertical high-speed end mill



Eclipse Type 635 starter



Tapping machine

materials to a width of 46 in. can be printed at the rate of 56 in. per minute.—AVIATION, *November, 1940.*

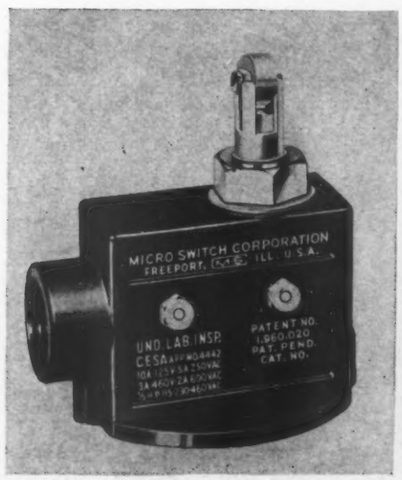
Although a bantam weight in size and cost, the new Univertical end milling machine developed by J. D. Duffy & Son, will handle much of the work normally done by machines costing five times as much. The Univertical mills, drills, bores, and is adaptable to small grinding operations. The swivel head spindle swings 90 deg. either side of the perpendicular. Speed range is 850 to 3,400 r.p.m. and cutting tools of $\frac{1}{4}$ in. to $\frac{5}{8}$ in. in diameter are driven by the $\frac{1}{4}$ hp. motor.—AVIATION, *November, 1940.*

Designed and developed primarily to meet the requirements of private pilots, the Eclipse Type 635 direct cranking electric starter has been announced for use on engines up to approximately 100 hp. Available with a 5-in. mounting flange and 12-tooth driving jaw, the starter weighs about 17½ lb. and is designed for 12-volt, one-wire, grounded operation. A heavy duty switch for foot type may be obtained separately for control of the starter motor circuit.—AVIATION, *November, 1940.*

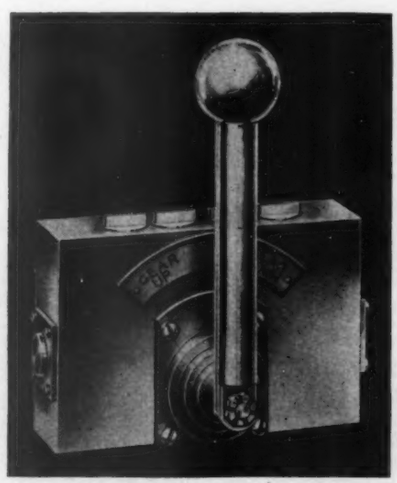
A characteristic of all aircraft and aircraft engine work is the large number of holes required to be drilled, and in many cases tapped with threads for bolts or studs. For this reason high speed tapping machines are finding increasing applications for production work. The new No. 5-A Kaufman Hi-Duty tapping machine announced by the L. J. Kaufman Manufacturing Co., Manitowoc, Wis., performs all operations with air pressure, including indexing, locking, and clamping of parts, which enables very sensitive operation in using all sizes of taps within its range. Dies can also be used for external threads. Work dials to accommodate 8, 12, and 16 stations can be furnished.—AVIATION, *November, 1940.*

Long life and precision performance are built into a new compact die cast Micro switch now available with hardened and ground actuating roller. Adjustment for actuation by cam or slide is provided. Exact point of operation is repeated millions of times on split thousandths of an inch differential movement. Rugged field wiring terminals accept up to No. 10 wire. The hub takes standard ½ in. conduit.—AVIATION, *November, 1940.*

One of the additions to the line of hydraulic equipment manufactured by the Adel Precision Products Corp., Burbank, Calif., is a four-way hydraulic selector valve in which provision has been made for either automatic or manual return from operating position to the normal neutral position. Incorporation of this feature has been accomplished without materially increasing the size of the valve, while at the same time presenting actually lower pressure drops than previous equipment. With a normal capacity rating of 10 g.p.m., the new Adel valve is designed to withstand pressures of 4,500 lb. per sq.in. No castings are employed in the unit, the main body being fabricated from dural bar stock.—AVIATION, *November, 1940.*



Die cast Micro switch



Adel automatic four-way hydraulic valve

The Birdmen's Perch

We think that maybe we've started something that will turn out to be mighty interesting in the Private Plane Insignia referred to below. I don't think anyone has really looked into the possibilities of decorating planes with individual insignia. Maybe we'll all get some swell ideas!

Major Al Williams, alias "Tattered Wing-Tips," Mgr., Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

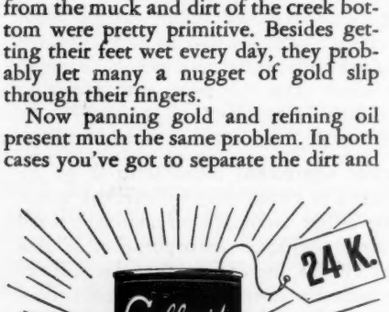
NEW BUSINESS DEPT. (Cont'd)

We wish you could have the fun of seeing all the private plane insignia that are coming in. The Army and the Navy boys have done a mighty clever job of thinking up trick insignia and it should be pretty interesting to see what the private plane owner has been doing. So send yours along. We'll publish the best ones soon.

GOLD, PURE GOLD

Remember the mountaineers with shaggy ears who used to squat along the banks of California creeks, panning for gold? Their methods of separating the gold from the muck and dirt of the creek bottom were pretty primitive. Besides getting their feet wet every day, they probably let many a nugget of gold slip through their fingers.

Now panning gold and refining oil present much the same problem. In both cases you've got to separate the dirt and



waste from the real thing. And over the years methods have improved tremendously in getting both gold and oil.

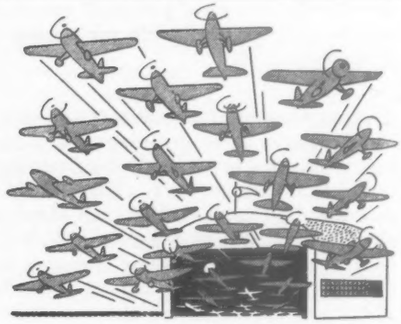
And when it comes to removing carbon-forming, sludge-producing wastes from motor oils, you have to doff your hat to the Alchlor process used in making Gulfpride. This Gulf-invented refining step is an "extra" that takes out additional quantities of the bad elements present in all oil, and leaves in *more* of the good ones.

The result: when you pour 100% Pure Pennsylvania Gulfpride into your engine, you give it the 24-carat protection it needs and deserves.

DO YOU BELIEVE IN DREAMS?

This one happened at a local airport the other day. The night watchman had just finished his duties at 6 A.M. and started talking with the manager of the airport.

"Last night," said the watchman, "I had a very peculiar dream. I dreamed that



someone had opened the doors of the hangar and that all the planes had flown off of their own accord. Nobody could be seen at the controls—but off they went."

"Nonsense!" replied the manager. "Planes don't just up and fly off by themselves. You've been eating the wrong kind of pie."

The manager, who was in a hurry to get started on a business trip, then left the watchman. But several days later, when he returned, he summoned the watchman to his office and fired him.

Why?

(Will admit you took us over the jumps on the cigarette puzzle last month. This one is tougher. Send your answers to T.W.T. We'll let you know whether you got it, by return mail.)

THIS MONTH'S WHOPPER

(Distaff Side)

Dear Major:

Don't breathe a word to my instructor—he hasn't found it out yet—but last week I had a forced landing on my first solo flight and washed out a tire.

It turned out to be a lonely and wild section, so I set out on foot to get to a telephone. Well, first thing you know, I looked up and there's a big, ugly rattlesnake lying across the narrow trail I was climbing. And he *wasn't* dozing!

He had that look in his eye that said, "I've had a hankering for something all day, and now I know what it is—a nice juicy bite of leg!" Now no snake-in-the-grass can look at little Betti like that and get away with it. The nearest thing at hand with which a girl might protect herself was a jug of G.A.G. I carry just for emergencies. So, grasping it firmly by the handle, I let fly. The jug of G.A.G. caught that reptilian masher right on the noggin, and the last I saw of him as I hurriedly retreated down the trail, he was licking up the splattered drops of G.A.G. with a happy, if surprised, grin on his face.

After I got back to the plane and had been sitting there about two minutes, I looked up and there was my little friend sitting up on his tail in front of me, begging for more. So I siphoned a pint out of the tank for him, and before you could say "San Luis Obispo" he was telling me about the wife and kiddies and what the boss had said to him and what he'd said back. I could see a crying jag coming on, so I quickly told him all about the washed-out tire on my plane.

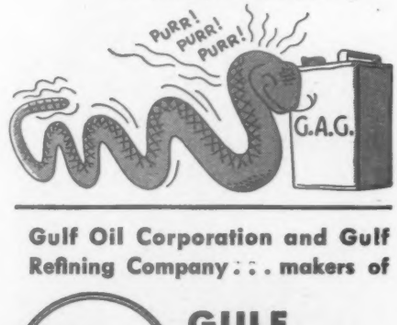
Well, the G.A.G. made him so smart he knew just what I meant. He went up to the wheel and curled himself around it with his tail in his mouth and says, "Well, what are we waiting for?"

"Nothing," I replied, taking off and beating it for home.

Now, major, the only thing that's troubling me is what to do with Lefty—that's what I call him. The SPCA has been after me, but Lefty refuses to untwist himself from the wheel. He claims it makes him feel good, getting his back scratched whenever I take off.

Since it's all G.A.G.'s fault, do you think you could square things with the SPCA for me?

Sincerely yours, **Betti D. Frye**



Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF AVIATION PRODUCTS

THE Aviation NEWS

BLAINE STUBBLEFIELD, Washington | C. F. McReynolds, Pacific Coast | Jay P. AuWerter, New York | E. R. Lockin, New York | NOVEMBER 1940

$40,000,000 is Voted for Airport Expansion More Funds Expected from Next Congress

CAA's airport expansion program can now begin. Congress finally appropriated $40,000,000 in cash for construction or improvement of not more than 250 fields selected by a special committee composed of the Secretaries of War, Navy and Commerce as essential to national defense.

Although the House approved an $80,000,000 fund, including $50,000,000 in contract authority, the Senate at first eliminated the entire amount—but not from disapproval of airports as such: unfortunately news accounts confused the relatively small initial appropriation with CAA's long-range six-year program of 4,000 landing fields, and Senators became embarrassed by hundreds of wires from constituents asking for federal airport money for every crossroads. Conferees were able to salvage half the program for this year.

Meanwhile, as the Army planned to move in on a number of existing commercial fields, and as airline traffic continued heavy, CAA ordered civil pilot training off of 46 of the more crowded municipal airports, as a first step in readjustment of aviation activities to protect against hazards to safety from dangerous congestion. Training planes may still be based at these fields, but flying cannot be conducted within 6 miles of the fields designated.

The National Aeronautic Association, which has been working for the past nine months with CAA in the development of the airport program, anticipated that expenditure of the initial $40,000,000 "will give strong proof for the need of continuing", while Rep. Woodrum (D., Va.) of the House Appropriations Committee stated that the new appropriation "opens the way" for furth-

(*Turn to page 82*)

Wide World

Great responsibilities may fall upon four of these men as U. S. air power moves toward world supremacy. L to R: J. J. Mullaney, chief clerk of Air Corps, administers the oath to promoted officers Maj. Gen. Jacob E. Fickel; Maj. Gen. Burton K. Yount; and Maj. Gen. Geo. H. Brett—who will be district commanders; and Brig. Gen. Carl Spaatz, made assistant chief of Air Corps.

Fairchild Airiel Surveys

You are looking down, from out toward Mount Vernon, on Washington's new National Airport, formally dedicated Sept. 24 when the President laid a cornerstone for the administration building. Four hundred and eight Army and Navy planes rumbled overhead. This is not the biggest, or the most expensive air field in the country, but its appointments are probably superior to any in the world. It will serve as a pattern in U. S. airport expansion.

NATIONAL AVIATION

Army and Navy Support CAA Pilot Training
Secondary Courses Increased for Military Need

Washington (AVIATION. BUREAU)—Politicians and their hired men have been confusing the record regarding the civil pilot training program of the Civil Aeronautics Administration. Because this project has been set up as a vital part of national defense, this journal has checked up thoroughly and reports, without prejudice, the facts.

If the Army or the Navy, or both, would publicly disapprove the civil training program, that would be its death knell. So that's where its opponents struck.

There are some responsible officers in both Services who disapprove CPT. Some of them have sincere reasons, and some are jealous of any military air training outside their jurisdiction. Critics' arguments against CPT are (1) trainees do not enter the Air Services; (2) time on low-powered equipment is worth very little; (3) trainees are not subject to military discipline. But these faults are found by individual officers. Army and Navy both, officially, approve CPT, and here are the answers of responsible authority, including those of CAA, NAA and others.

Applicants for training are now required to pledge service to the arms of the United States. Those who have already received training are subject to the draft, like other persons.

There are no facts, but only opinions as to the value of CAA training to Army and Navy. Only a few primary trainees and only a few graduates of the advance courses have been received; therefore any criticism would be premature and none has been made as a matter of policy. CPT cuts the attrition rate substantially, and therefore cuts costs of air arm training,—enough to more than justify its existance.

CPT primary training is being decreased, while secondary is being increased. Only 10 percent are selected for advance, which is the most drastic weeding-out job ever done, in service or out.

The fact that Germany's training experience was on a civil basis is a weighty recommendation of the method.

High officials tell AVIATION that when they have criticisms, they will go to Assistant Secretary of Commerce Robert Hinckley, and CPT Chief Grove Webster, and ask for changes. They have no intention of taking over the program. They point out that this project was drawn up, from the first, by CAA and the Service cooperating.

Some officers do say that in their personal opinions it might be necessary for the Army to "take over" in real emergency. That probably would mean simply complete militarization of the setup as it stands. The wide distribution of training CPT facilities is a big advantage to trainees, and to the Air Corps, pressed for space as it is.

Lack of military indoctrination during the first few hours of training is of little importance, say practically all officers.

CPT was the only way to start mass training. A year ago the public would not have stood for frankly military training of thousands of boys. The value of CPT as promotion of personal flying is not questioned by anyone.

The National Aeronautic Association was instrumental in suggesting useful changes in CPT which won the approval of individual Army and Navy objectors. The Private Flyers' Association is on record as approving CAA's training program.

Of course changes may be expected, especially if the Administration changes hands, but these are the facts as of the present.

Redcoats Are Coming

If you're old enough, you recall how the Canadians trained pilots in Texas' mild winters during the World War. They had those light Jennies with four ailerons, which flew like Spads compared with ours. The Cadets often crashed before breakfast, because they were in a hurry. Vernon Castle was one of them. Well, the Canadians are in a hurry again, and they're coming to Texas—and the South generally. President Roosevelt said he didn't know any law to prevent Canadian civilians from training in U. S. civil schools; and what they did with their skill later on is their own business. When and in what circumstances Dominion military air training will move to our winter climate is for you to guess.

(*Continued from page 81*)

er requests from CAA as need arises.

The WPA airport program will continue unaffected. During the past three months, 70 WPA airport projects estimated at $21,500,000 were approved by the President—a rate of approval twice as great as a year ago.

The Civilian Conservation Corps also announced construction of 63 airplane landing fields. These, however, are unrelated to the defense program but designed for use in forest fire protection.

Wide World

OVER EIGHT MILLION CANDLE-POWER is developed by this searchlight, being used by Battery A, 68th Coast Artillery, at Camp Edwards, Mass. Listening device at the right picks up sound of approaching airplanes, and automatic device aims searchlight on the planes.

SPOT CHECKING

Fuselage section manufacture by auto subcontractors is urged by Knudsen, who thinks plane builders can't get big presses quickly. Some engineers say auto makers don't have proper experience.

After months of service, T. P. Wright, Samuel Herron, and Dr. Edward S. Taylor, resigned their aviation posts in Defense Commission.

North American Aviation, Inglewood, Calif., has general executive reorganization.

Jesse Jones, Secretary of Commerce says aviation is fast becoming one of the most important industries in the world.

Air Youth of America announces $4500 worth of aviation scholarships for high scholastic records and aviation activity by high school students.

Wright Aeronautical get a War Department order for $81,569,140 worth of engines. Part will go to Navy under joint purchasing agreement.

Glenn Martin's plant expansion will bring floor space to 3,800,000 sq. ft.; will employ 40,000 people; backlog is $400,000,000.

Canadian training planes are being delivered at the rate of 100 per month. Over half of 808 required are completed.

Air Pick-up, Pittsburgh-Huntington, starts Nov. 12. Pittsburgh-Williamsport starts about Dec. 1.

Fort Wayne, Indiana, designated by War Department as site of new Air Corps station, 140 officers and 1200 men.

Lycoming, of Aviation Manufacturing Co., gets Army order for $6,703,539 worth of airplane engines.

Republic Aviation starts a million dollar program to train 8000 aircraft workmen.

Civil Aeronautics Board has invited airlines to a meeting Dec. 2 to discuss a new method of determining rates.

Los Angeles-Mexico City route has been recommended for award to Pan American Airways, by a CAB examiner.

Seattle-Alaska line will be operated this winter with Lockheed Lodestars, instead of the 4-engined Sikorsky flyingboats.

National Airport Open Begins Service Dec. 17

Washington (AVIATION. BUREAU)—With 408 Army and Navy warplanes criss-crossing formations overhead, including 24 Flying Fortresses, and transport ships making trial landings, the President, on Sept. 28, dabbed a trowel-full of mortar under the cornerstone of the administration building, thus dedicating Washington National Airport, at Gravelly Point. The port will open for business Dec. 17 (Kitty Hawk first flight day) with all service features.

There will be six hangars, to accommodate all foreseeable traffic of American, Eastern, and Penn-Central, and other lines which may come in. At each plane position gasoline, oil, electricity, conditioned air, and phone connections will be available; no trucks on the apron. National Airport will be a sightseeing mecca, with a Presidential Suite for bigwigs; a huge dining room with lofty glass windows overlooking operations; $300,000 worth of swank decorations (paid for by concessionaires); parking for 8,000 cars. All this elegance is expected to make concessions pay running expenses and amortize the $13,000,000 cost—which incidentally cancels out recent Congressional criticism that money was wasted. With 144 scheduled traffic movements per 24 hours, Washington is the third busiest port in the United States.

Congress has passed resolution authorizing the President to designate Dec. 17 as Pan American Aviation Day. The President may call upon everybody to take an interest in transportation and communication between the Western Hemisphere countries. Plans are being considered to combine the airport celebration with the Pan American festivities.

WPA Will Train Ground Crew Men

Washington (AVIATION. BUREAU)—A plan to train 5,750 selected WPA enrollees as aviation ground service men at a cost of $1,430,000 of WPA funds, has been approved by the President. Purpose of the training is to meet the rapidly growing need for ground men in civil and military flying.

Two to three months training will be given to groups of ten to fifteen men at about 100 airports to be designated by the Administrator of Civil Aeronautics. Trainees need not be mechanics to start. It is expected that many graduates will be needed by Civil Pilot Training airports. Some of them, of course, will be taken into the Army and Navy.

First move will be training at Washington of a staff of about 100 instructors, non-WPA men who have had previous airport experience. They will then return to their communities and take up duties at local airports.

For information write Work Projects Administration, Howard O. Hunter, Acting Commissioner, Washington, D. C.

Duke & Duchess of W

Miami All-American Air Maneuvers, Jan. 10, 11, 12, will have "Miss Aviation—1941," "Miss Miami Aviation—1941," and "Miss Pan American." Listen, you boys better keep your eye on the horizon down there. And watch your grammar, too. Pan American is an adjective. What you want is a noun. If you'll make it "Miss Pan America," and if you'll put the Duke and Duchess of Windsor and all those airplanes and stuff on display, as you say, we'll give you A plus.

YOU WON'T RECOGNIZE THIS as a Stinson 105, but that's what it is. This picture was taken in France, where the ship was used for coastal patrol. Now the plane is being used for the same purpose in England.

THE WASHINGTON WINDSOCK

by BLAINE STUBBLEFIELD

World's Two Fastest Planes

"No comment," said the Post Office Department, when asked why all U.S. mail for Germany and Poland has been routed over the Atlantic. Much of it has been going via Japan and Russia. The reason is: so the British censors can read it. We hear that PAA often stops at Bermuda for same reason.

Nazi planes come down in England by hundreds. Many are completely intact, are thoroughly studied; British know every detail of all models. So does the United States.

Transposition of function of rudder and elevator when the plane turns on longitudinal axis is still argued hotly by aerodynamists; some contend that student flyers are not told obvious facts they need to know for safety. Their point is that there is no transposition.

First underground hangar we hear of is reported being built by the Navy at the Virgin Islands base. This was a natural; had to scoop out a hill anyway, so left the top on it.

British airbase deals will come home to roost after the war. If England survives she will want some U.S. spots in the Pacific, particularly Hawaii, to continue her airline around the world.

If you ignore NAA as a matter of habit, change your ways. The National Aeronautic Association has three of the livest wires in this business, all effectively throwing their weight around Washington and the country.

New "mystery fighter" defending London is probably nothing more mysterious than the Curtiss P-40. A little extra spondulix can make a whale of a difference.

Styles in destruction change overnight. Right off the boat comes information that deadly AA fire in Europe has practically stopped dive bombing. Next thing is more hedge-hopping, and better accuracy from high up, in which the U.S. is supposed to excel.

Army and Navy should get together on their boasting. Barely a couple of weeks after Air Corps Chief General Arnold announced his new Lockheed would do 500 m.p.h., Admiral Towers of the Bureau of Aeronautics claimed he had the fastest plane in the world—a Vought fighter which will break 400.

A five-line Army release announces a single airplane contract—to Douglas for $141,321,000—which considerably exceeds the total expenditure on aircraft in the ten years 1925–35.

Curtiss fighter that French say was best airplane in air during fighting last spring was a P-36, two models back from ships now being produced. It was sold before export of latest models was permitted.

The Stubblefield award again goes to Northwest Airlines (this time no razzberry) for thinking up the smartest traffic trick. They sell a ticket to prospective car owner who flies East, takes delivery at FOB price, drives home with a saving and an air trip under his belt.

U.S.-Canada Air Routes Are Allocated

A conference of United States and Canadian officials have worked out a tentative allocation of existing and proposed air routes across the border as between U.S. and Canadian lines. Proposals, which must be ratified by higher-ups in both governments, call for a Canadian service Toronto to New York, non-stop, and that Trans-Canada be permitted to cross the line into Detroit.

"We Are Here"—Again

The Eagle Squadron, an all-American fighter command, upholding the traditions of the famous Lafayette Escadrille of the World War, soon will take off with RAF. The squadron consists of 34 qualified American pilots. Honorary commander is professional soldier Col. Charles Sweeny, who has the rank of group captain in the RAF volunteer reserve. Training is in progress at an unnamed airdrome in Britain.

Nat'l Aeronautics Notes

Every day the NAA is increasing its activities in civil and military aeronautics for the public interest. The present management is trying to make NAA a real power in American aviation, and it is about ready to seek the cooperation of a large number of national leaders. For twenty years now, people have been saying aviation will be a great thing some day. It's liable to happen, after this emergency, while they're still talking. If some planning isn't done, we may find ourselves in an air jam as bad as the motor-traffic mess, from which it seems no power on earth can extricate us. NAA is trying to look to the future, as well as to present defense problems.

H. Ray Ellinwood, president of Adel Precision Products Corp., manufacturer of aircraft accessories and hydraulic equipment, has announced the appointment of Harold Webb, formerly assistant to the president of Vega Airplane Co., as assistant to the President.

The Judgment Day

Mrs. Kidd had a commercial pilot's rating, all right, and she was supposed to be instructing CPT students in the Southern Aviation School which she and her husband operate at New Orleans. But sometimes she didn't; she let Mr. Kidd take them up, and this was all wrong, because Mr. Kidd is only a private certificate man. Not only that, but when Mr. Kidd came down he rigged the books so that they showed that Mrs. Kidd had given the lesson. Trouble comes double. People told the Civil Aeronautics Administration that Mr. Kidd flew those students on the civil airways near New Orleans. And the Coast Guard said he flew low and dangerously—with a student—over their station at Biloxi. You guessed it, reader. The judgment day is here. Mr. and Mrs. Raymond Lee Kidd's certificate has been suspended, and those Washington lawyers want them to "show cause" why their school and pilot badges shouldn't be lifted for keeps.

How to Crash

There's no use mentioning the names of unfortunate people who were killed or seriously injured in recent non-airline accidents. In August, 26 lost their lives, to say nothing of loss of and damage to aircraft. Here's how some of them did it:

Two glider pilots, both trying to ride the same updraft, collided, crashed, died. Flying an uncertified, unstable plane, inexperienced pilot spun, seriously injured. Pilot executed acrobatic maneuver at low altitude, spun, self and passenger seriously hurt. Pilot stalled at low altitude in steep turn, spun, five people killed. Pilot took up tail-heavy ship, control cable jammed, spun, killed himself and one other. Student pilot cut switch while flying low over rough water, dropped in, injured self and instructor. Flying 50 ft. over corn field, looking for stray calf, stalled, dropped nose-down, killed. Home-made plane, low turn and coyote hunting was a fatal combination. Glider, on tow, hit barn; serious injury. There are lots more, but they are pretty much alike.

Calling Names

Harold Crary, vice president United, flew to Alaska in Pan American Clipper.

H. W. Rohl, Los Angeles contractor, is the country's most unusual air traveler. He charters 21-passenger United planes and flies in them all alone.

Lief Baumbach, from Northwest, takes charge of a new passenger service department for Penn-Central, assisted by Chief Hostess Geraldine Grimm, who's flown 100,000 miles.

Mary Elizabeth Nutter, with Penn-Central two years, takes charge of the women's traffic promotion.

John Stuart, former press man for CAA, is publicity man for Washington National Airport, under the Administrator. We saw him talking to President Roosevelt.

Clinton M. Hester, former Administrator of CAA, who served 21 years in eight Government departments, has opened general law offices in Washington. He flew 300,000 miles with CAA, made first flights to Europe, Asia, Alaska.

"New Horizons", new magazine on international air travel, is distributed via PAA to 55 countries.

Southern Nevada Aero Club announces that Nevada's greatest air show will be at Las Vegas, Nov. 10.

Lieut. Robert B. Kinkead, traffic man for United Air Lines since 1933, is commissioned and serving with the press office of the Air Corps, Washington.

World War fliers, Legion Air Post 501, which lists many famous ones, meets in New York, decides U.S. will lead military aeronautics soon. **Frank K. Hummel** elected Post Commander; **J. S. Allard, E. P. Behr, J. W. Bellach** and **Wythe Williams,** Vice Commanders.

Maj. Gen. Henry C. Pratt is relieved from duty in the Philippines and assigned to headquarters, Ninth Corps Area, Presidio of San Francisco.

John A. Roebling's Sons Co. has appointed **Roger H. Clapp** assistant general manager of sales, and **Earl N. Graf** assistant manager of sales, wire rope division.

A. W. Stephenson, formerly division superintendent of Western Air Express, has been named supervisor of operations of Seaboard Airways.

Appointments at Vultee Aircraft include **Robert B. Brown** as works manager of the Nashville Division, **G. T. Boyce** as controller, and **Gerald J. Donahue** as advertising manager.

Lt. Col. J. Victor Dallin has resigned as manager of the new Philadelphia airport to become director of the Pennsylvania Bureau of Aeronautics.

A. M. Rochlen of Douglas Aircraft was elected chairman, **L. D. Lyman** of United Aircraft, vice-chairman, and **Howard Mingos,** secretary of the Public Relations Committee of the Aeronautical Chamber of Commerce.

Brown & Williamson gives away a Piper Cub every week for the best testimonial on company's cigarettes. Not only that, but testimonial gets read over radio too on "Wings of Destiny" program.

Otto P. Graff is manager of parts sales and customer service division of Vega Airplane Co. Was previously in charge of British Air Ministry contracts.

Robert L. Drake, Lear Avia's vice president and chief engineer has produced a new model; christened Nancy Elizabeth.

R. J. Barton joins Tool Steel division of Allegheny Ludlum Steel, in the Southern California territory; **C. A. Peck** in the Chicago office.

Glynne M. Jones, former senior aeronautical inspector of the CAA at Roosevelt Field, has been appointed manager of the New Orleans airport.

Stanley T. Johnson, managing director of Aviation Developments of England, is on a trip through Canada and the U. S., to inaugurate the manufacture of Chobert blind rivets and riveting guns.

Robert C. Stanley, president of International Nickel, is the first recipient of the Charles F. Rand Gold Medal.

Clifford B. Hutcheon, formerly with Anemostat Corporation, is now chief engineer at Plandaire, Inc., manufacturers of Kno-Draft air terminals.

Gilbert L. Wolfe is appointed representative of American Nickeloid Co., to cover central New York state for their pre-finished metals.

Tom A. Burke, for ten years director of publicity for the National Safety Council, is executive vice president of the Greater New York Safety Council.

Harold Dahl, of the romantic Franco episode, is now flying with the Royal Canadian Air Force.

Earl Ortman, racer, is reported now a test pilot "somewhere in England."

Smythe Enoch Gambrell has been appointed general counsel for Eastern Air Lines.

John L. Schmeller has been made vice president in charge of sales of the National Bronze & Aluminum Foundry Co.

George M. Johnson succeeds his father, **Robert S. Johnson** as president of Gisholt Machine Co.—the third consecutive generation of his family to hold this position.

J. C. Curtis, instructor at Boeing School of Aeronautics, is succeeded by **Charles C. Clarey** as station manager for U. A. L. at Des Moines.

L. A. Kavanagh and **Carleton Darneal** are sales executives for Interstate Aircraft & Engineering Corp., to direct the sales of the new Interstate Cadet.

HEADS of the newly formed Air Safety Radio Corp.: left, Ralph Clark; right, George Arents, Jr., with George's Spartan. Arents owns and manages Armonk Airport, in Westchester and is president of the firm that will make aircraft radios operating on ultra high frequencies. Clark has been building radio equipment for years.

Plane Standardization As Problem Solver Has Now Been Deferred to '42

Washington (AVIATION BUREAU)—Standardization of airplane types was the panacea a few months ago that was going to provide lots of plants quick. Now that the program is drawn up and most of the contracts let, it turns out that the planners were too optimistic. There has been some reduction in the number of Army types, but in general standardization has been deferred until the big model change in 1942.

Only in the case of the light attack bombers has Army standardized on a single combat model, a Douglas. The Vultee basic trainer is now standard, but on all other types at least two models and sometimes more are being bought.

The vital question of standardization as between British and U.S. demand has hardly been touched as yet. An exception is the Curtiss pursuit plane, P-40D, which is identical with the export model. Navy and the British are attempting to get together on Consolidated ships, but more typical is the situation at Martin, where parallel assembly lines are turning out one medium bomber for this country and a different one for England.

Basis for this situation is the decision that in a period of major expansion (from a present 10,000,000 sq.ft. to about 25,000,000 sq.ft.) production can only be held at a high level if each manufacturer is working on types he is familiar with. This applies especially to engines and reflects over into airplanes; when two engines of similar output are differently shaped, there have to be different airplanes to use them.

In 1942, when the major part of the expansion will have been accomplished and the 35,000-plane program completed, the picture will change. In going over to new models for the next U.S. and British program, it will be possible to do some real standardization, and the designers are now working on that basis. If we are at war, this will mean one model in each type. If not, we will probably retain some competition by using two of each type.

Under the present program Army is buying two heavy bombers, Consolidated and Boeing. There are two medium bombers, Martin and Douglas. There are four single-engine pursuits; Republic, Bell, Curtiss, and North American. Both Lockheed and Grumman are making two-engine pursuits. No attempt at all is being made to standardize primary trainers.

Appointment of a committee on standardization of plane output (Knudsen, Stimson, Knox, Morgenthau) has nothing to do with standardization of types, though the administration is not averse to letting the public, thoroughly sold on that objective, get such an impression. Purpose is to put some high-power names behind the drive to make the British accept U.S. standards as to the details of the planes they buy. This is particularly important in the cases where the British are buying substantially the same ship as this country—such as the P-40—and won't mean so much where separate assembly lines are maintained.

However, a secondary motive is to provide prestige for a committee of the Army-Navy Aeronautical Board which has been working on interchangeability of aircraft parts. This committee is working down at the level of the thread on screws and the location of holes on a generator base; eventually it will work up to more important sub-assemblies as far as the job can be carried without upsetting production.

War Department Assignments

The War Department has assigned the following generals to new stations: Maj. Gen. Frederick L. Martin commands the Hawaiian Air Force; Brig. Gen. Herbert A. Dargue is assigned as Assistant Chief of the Air Corps in Washington, D. C.; Brig. Gen. Douglas B. Netherwood is assigned to duty in the Panama Canal Dept.; Brig. Gen. Gerald C. Brant assigned to command the Gulf Coast Training Center, Randolph Field; Brig. Gen. Rush B. Lincoln commands Air Corps Technical Schools, Rantoul, Ill.; and Brig. Gen. Davenport Johnson is assigned as Assistant Chief of the Air Corps, Washington, D. C.

A Defense Auxiliary

The Civil Air Reserve proposed by the National Aeronautic Association is getting into the serious talk stage with Service officials. The idea is to organize thousands of civilian fliers into trained groups as a defense auxiliary. There would be a headquarters group in each state, coordinating through a national office. Duties of the reserve would be non-combatant patrol, reconnaissance, mapping, transport, disaster, relief, etc. NAA believes that if civil flying is not given a part in defense plans, the military will dominate U.S. aviation too much. After all, it is private aviation on which the aircraft industry must grow after the present military effort is finished.

National Defense

The actual strength of our air forces is a mystery which can be expected to deepen over the approaching winter as the British situation becomes more precarious. For while there is no question that United States supremacy in the air is the accepted policy of the government there is a question whether that policy is interpreted in official sources as meaning production capacity or planes on hand.

Complete accord will never be reached on this controversial point, but the balance at present appears in favor of supplying the British with American aircraft so long as there exists a chance that this may keep the war away from the Western Hemisphere. This determination is bolstered by the familiar justification that in so doing, our manufacturing activities can be expanded to the place where accelerated output will of itself assure our supremacy, while we await the advantages of war experience and design improvements incorporated in "later models."

'Chute Corps Planned

Starting with a nucleus of the 48 enlisted men and two officers trained at the Hightstown, N. J., parachute jump school, the Army is forming 500 parachute troops at Fort Benning, Ga., to be known as the 501st Parachute Battalion. Maj. M. Miley will be in command. Beside the nucleus trained at Hightstown, additional men will be drawn from the regular Infantry.

Wide World

HALF A DOZEN PARACHUTISTS of the new 501st Parachute Battalion after they have made successful jumps at Fort Benning, Georgia.

BETTER THAN THE STUKAS, is Douglas' promise of this dive bomber's performance. Known as the SBD, this ship carries a crew of two, has great speed and a long range. Perforated, hinge-type flaps help to account for this dive bomber's value.

RUGGEDNESS PROVED BY "Torture Tests!"

... to bring you an important margin of safety!

Here's Airline Safety in a Light Plane Receiver at only $99.50

FOR B-BATTERY OPERATION

RCA MODEL AVR-15

with *Separate* Traffic Control Channel

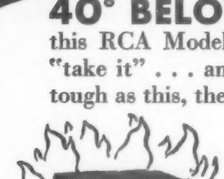
HERE, at the price of a "bargain-quality" radio, is a real *quality-radio* bargain! RCA-built, CAA-approved, and tested under conditions which would quickly put a dressed-up broadcast receiver out of commission, the RCA Model AVR-15 brings you *extra* ruggedness, reliability and efficiency, for uncompromising safety... *plus* the convenience of a separate Traffic Control Channel! Just a snap of a switch shifts your receiver from Tower frequency to Beam frequency . . . *instantly*. No dial-twiddling. No lost time. You need not take your eyes from your flying!

Yet the RCA AVR-15 is yours for only $99.50, for operation from light, compact "B" Batteries! With 6- or 12-volt Vibrator-Type Power Supply, it's only $133.50.

Don't buy any aircraft receiver until you've seen how much extra quality and performance RCA can give you for so little. Write today for literature—*now*, before you forget!

40° BELOW ZERO! In sub-Arctic temperatures, this RCA Model AVR-15 receiver had to prove its ability to "take it" . . . and perform perfectly! Through a dozen tests as tough as this, the AVR-15 came out with flying colors!

131° FAHRENHEIT AT 95% HUMIDITY! As hot as the steaming jungle at its worst! And the AVR-15 still performed perfectly for hours without dangerous overheating!



SHOCK TEST. 100 free falls from heights of 6" to 18", without shock mountings of any kind! Tests like this prove the AVR-15 can take the brunt of rough treatment day after day and not let you down!

VIBRATION TEST. Prolonged vibration is something every light-plane receiver must meet in service. This test, far more severe than any actual conditions your receiver will ever meet, proves the AVR-15 will stand up indefinitely without breakage, loosening, or circuit-component changes, at vertical accelerations as high as 10 G's!

For Dependability, it pays to use the tubes preferred by most airports and pilots—RCA RADIOTRONS

RCA

for Aviation Radio

RCA MANUFACTURING CO. INC., CAMDEN, NEW JERSEY
A SERVICE OF THE RADIO CORPORATION OF AMERICA

All Army Planes Ordered Half Combat Half Trainers

Unofficial Estimate of Numbers by Types

Washington (AVIATION BUREAU)—Army announced last month that last ship in its 19,000-plane program had been placed under contract—about three weeks after the bulk of the money became available and a little over three months after money for the partial 4,000-plane program was appropriated. All were contracted before the tax and amortization bill was signed.

Just what sort of airplanes are under contract has never been officially announced. For the first 4,000 or so units, Army released quantities and types just to convince people they really were ordering planes. But after that War Department shut down on information except dollar totals. However, on the basis of scraps of information, some careful guessing, and a few stabs in the dark it is possible to get a rough idea of what's in the program.

On this basis, it appears that the orders are about equally divided between combat and training types. And it might well be that in an emergency the nearly 6,000 advanced trainers might have tactical value; back in the early '30s a 600-hp. fighter would have been considered pretty hot. It is worth noting that without any allowance for replacements and spares, this program will call for better than 9,000 radial engines in the 1,500 to 2,000 hp. bracket, a like number of smaller radials, and about 6,500 liquid-cooled engines of 1,000 hp. or better.

The following table is distinctly not guaranteed. Probably no figure in it is exactly right; possibly there are substantial errors. But it offers as good an approximation of the dimensions of the program as is now available.

PLANES ORDERED FOR AIR CORPS UNDER 1940–41 APPROPRIATIONS

850	Heavy four-engine bombers
500	Boeing
350	Consolidated
3,550	Medium two-engine bombers
1,150	Martin
1,400	Douglas
400	Two-engine attack fighters
400	Douglas
600	Two-engine pursuit
600	Lockheed
5,250	Single-engine pursuit
1,750	Curtiss
1,800	North American
1,000	Republic
700	Bell
9,650	Total combat
170	Transport
50	Curtiss
20	Beech
100	Douglas
5,700	Advanced trainers
2,000	Curtiss
3,000	North American
700	Beech
500	Basic trainers
500	Vultee
2,950	Primary trainers
800	Ryan
800	Fairchild
1,360	Stearman
9,320	Total non-combat
18,970	Total all types
18,640	Official total

Wide World

THE BRITISH got these Republic pursuits which were originally ordered by Sweden. Ships were built and then crated. As months went by, the pile of boxes grew and Republic bought a circus tent to keep off the rain. Now State Department has approved them for England.

Plane Output Behind Schedule

Rapid expansion of aircraft plant is interfering with concurrent production more than had been originally estimated. As a result output in October will be about 200 units below schedule — will approximate 900–950 military and civil craft exclusive of Cubs. This rate is about the same as that of August. It is still hoped, however, that production can reach 1,250 units a month by year-end and 1,500, by July 1; thereafter the schedule calls for a steady rise to 3,000 in the spring of 1942.

Engine production is going better. In September about 1,500 combat engines (1,000 hp. or better) were turned out plus about 900 smaller engines for trainers and civil craft.

Buick and Studebaker reportedly are now negotiating to build 2,000-hp. radial air-cooled Wright engines on a licensing arrangement similar to that under which Ford is starting to build Pratt & Whitneys. Said to be planned is an eventual output of 1,000 a month by each of the two firms.

All aircraft and accessory plants, the Air Corps says, are now working three shifts. The Secretary of War's recent order that three shift production be instituted, though it got a big play in the headlines, was a mere formality to permit use of the $120,000,000 which has been appropriated to pay the overtime and other costs of 24-hour operation.

Profit Limitation Changes Form

Passage of the excess profits tax bill means two major things to aircraft manufacturers. First, the expanded plant that they are all undertaking can now be written off their books in as short a time as five years without their having to pay taxes on the amount charged to amortization.

Second, the old Vinson-Trammell limitation on profit that can be made on U.S. government aircraft is gone. In its place is a profit limit that in some cases might be even more severe—because it applies to British and civil as well as to U.S. business, and because the limit is now a percentage of capitalization rather than, as formerly, a percentage of gross business.

To airline operators, flying schools, and other non-manufacturing elements of the industry the bill means—if they are incorporated—that for the first time their profits are limited by law.

To all corporations earning more than $25,000 a year it means a 3.1 percent increase—to 24 percent—in normal income tax.

Briefly, here is what the bill says:

All corporations having more than $5,000 of "excess" profit may pay a tax on the excess ranging from 50 percent on more than a half million, down to 25 percent on excess profits under $20,000.

Excess profits are those amounting to more than 8 percent of invested capital. An exception is the case of firms which in past years have earned substantially more than 8 percent; these may compute excess profit as the amount by which current profits exceed 95 percent of the average profit 1936–39 inclusive.

Firms which have completed defense plant construction since June 10, 1940, may deduct a 20 percent amortization credit from gross income in computing net taxable income each year for five years.

Corporation income tax on all firms earning more than $25,000 a year is jacked 3.1 percent to 24 percent.

Vinson-Trammell profit limitations on ships and airplanes are repealed.

British Order Full Plant Output

The niggling attitude which has characterized British procurement ever since war's outbreak is finally beginning to be liberalized. Contracts are now being signed containing no quantities but agreeing instead to take the full output of whatever portion of the plant's capacity is allocated to export by the defense commission. However, only a few weeks ago at least one major manufacturer had an assembly line tooled up to produce 100 combat ships a month, which had been standing idle for nearly three months while financial and technical details were worked out on the next order.

The whole question of capacity allocation between export and domestic demand is, of course, vital to manufacturers. In spite of all concessions made on plant investment, few manufacturers expect to profit much from U.S. orders.

UTILITY

F17D Jacobs-powered BEECHCRAFT biplane owned by Star Airlines, Anchorage, Alaska. Cloth covers afford partial protection for upper wings, engine, and propellor while the plane is staked out.

From Alaska to the Antarctic, the BEECHCRAFT biplane has demonstrated its utility under the most extreme climatic and operating conditions. Its inbuilt sturdiness has earned the complete confidence of pilots and operators.

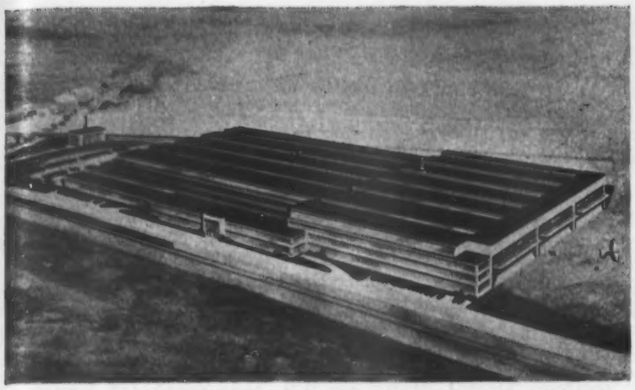
Combined with its staunch dependability are high pay-load, and honest cruising speeds of 177 to 202 miles per hour — performance unequalled in its horsepower classifications. Negative wing stagger, an exclusive BEECHCRAFT feature, is a source of high inherent stability and unexcelled visibility. Luxuriously comfortable cabin and seating arrangements are provided for five persons, with a cruising range ample for extended cross-country trips.

In the service of airlines, commercial and charter operators, government agencies, and private and corporate owners all over the world, the BEECHCRAFT biplane is recognized as a reliable piece of equipment.

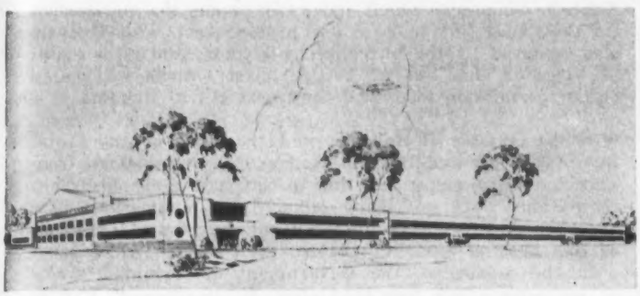
Your BEECHCRAFT dealer will be glad to show you how the unique qualities of the BEECHCRAFT biplane can be utilized in your service. Deliveries can still be made with reasonable promptness, in view of the defense situation.

BEECH AIRCRAFT CORPORATION
6411 CENTRAL AVENUE WICHITA, KANSAS, U.S.A.

BEECHCRAFT



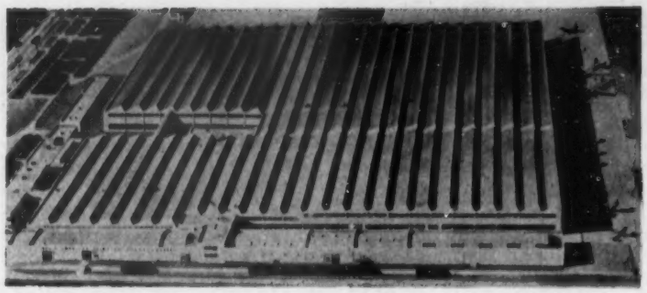
Designed for high-speed aircraft production, Curtiss-Wright's new plant at Buffalo, N. Y., will comprise 1,100,000 sq. ft.



Bell Aircraft's $1,050,000 building at Niagara Falls, N. Y., will supplement assembly at the Elmwood Ave. plant.

North American's windowless and air-conditioned factory at Dallas, Tex., will cover 1,000,000 sq. ft.; cost $7,000,000.

Grumman's new blackout factory at Bethpage, L. I., will cover about 500,000 sq. ft.; employ 4000 men.



The Inglewood, Cal., plant of North American will have a million-foot area by year-end.

Aircraft and Engine Plant Expansion Reported Now In Progress or Projected

Packard Motor Company: reported spending $30,000,000 of its own money plus $8,000,000 RFC loan for plant to produce 9,000 Rolls Royce engines, beginning in 10 months at 20 engines per month increasing to 840 per month in 15 months from contract date, plans to employ 14,000 workers in addition to present 10,000. It is understood that Britain is furnishing some of the capital, against future delivery of engines.

Wright Aeronautical, spending $92,000,000 RFC money, for plant space which will increase capacity to 12,000 engines a year. About $37,000,000 goes into a new 1,000,000 sq.ft. plant at Lockland, Ohio, employing 12,000 to 15,000 workers. Some of balance goes to subcontractors' plant increases. One is Studebaker, which will make Wright parts in expanded plant at South Bend and rehabilitated plant at Detroit. About $2,000,000 of the RFC loan goes into the Curtiss propeller plant at Caldwell, N. J. For machine tools, about $8,000,000. Completion expected in two months. Capacity of Wright Aeronautical Cincinnati Plant, 1,000 engines per month.

Curtiss-Wright Corp., Buffalo, spending $51,160,000 RFC money for new aircraft plants and equipment at Buffalo, Columbus, Ohio, and St. Louis, including $15,000,000 for labor and materials, and $2,160,000 for machinery and equipment, total $51,160,000.

Pratt & Whitney, (Division of United Aircraft) spending $15,000,000 own money expanding East Hartford plant, doubling floor space of Vought-Sikorsky, and adding another bay to Hamilton Standard Propeller. Most construction contracts have been let and large machine tool purchases are under way. Company already spent $16,000,000 in last 18 months for new plant; employees increased same period from 5,000 to 15,000. To meet its Army-Navy quota P & W will license Ford Motor Co. to build 1650 hp. double row wasps engines at $1 license fee per engine.

Glenn L. Martin Co., spending $24,000,000 own money to increase floor space 1,000,000 ft. to near 3,000,000 ft. Recently expanded plant in record time of 77 days. Claims to be first to break ground in defense program; without waiting for amortization legislation. Expect to have new space in production by new year. Use $1,000,000 new machinery.

Ford Motor Company, will build new plant on the Rouge for production of Pratt & Whitney engines undoubtedly using its own money. Equipment needs are being surveyed. Ford is reported about ready to start production of his own liquid-cooled engine, presumably based on the Rolls Royce design which he had in the works for months and finally dropped.

North American Aviation Inc., has broken ground for the 1,000,000 sq.ft. factory at Hensley Field, near Dallas, Texas. Construction has begun on the $7,000,000 plant which will employ 12,000 persons by the end of 1941.

Boeing Aircraft Co., spending $10,000,000 RFC money for increased plant, two thirds of it at Seattle and the remainder at Wichita, where Company's Stearman plant builds primary trainers.

Jacobs Engine Co., report says, has awarded contract for $1,000,000 plant at Pottstown, Penna.

Kellett Autogiro Corp. is adding a new unit which will increase

(*Turn to page 91*)

ON SCHEDULE

by "VISTA"

The imminent spread of the war to the Balkans will naturally have a profound effect on the few airlines still operating in this part of the world. Athens, which once was the last port of call in Europe for as many as five international airlines, making their scheduled runs to the Near and Far East, has been deserted ever since the war came to the Mediterranean. Only the Italian line passes through there now sporadically on flights to the island of Rhodes; the other lines have either been forced to stop their operations completely, or transfer their bases to areas where they will be safe for the moment.

Actually, air traffic in the Balkans was never very popular, the countries were not airminded enough for large-scale operations, and weather conditions north of Greece made flying practically impossible during six months of the year. Some of the international lines chose this route for their summer operations, because the route was shorter, but as soon as fall weather arrived, services were shifted via France and Italy.

News comes from Switzerland that the Swissair once again has started operations; they have now received permission to operate services from Locarno (a resort town south of the Alps) to Rome and Barcelona, Spain. The latter service will undoubtedly become very popular, as it will eliminate the difficult and somewhat dangerous bus service through France for persons on their way to Lisbon to take Pan American's booming trans-Atlantic line.

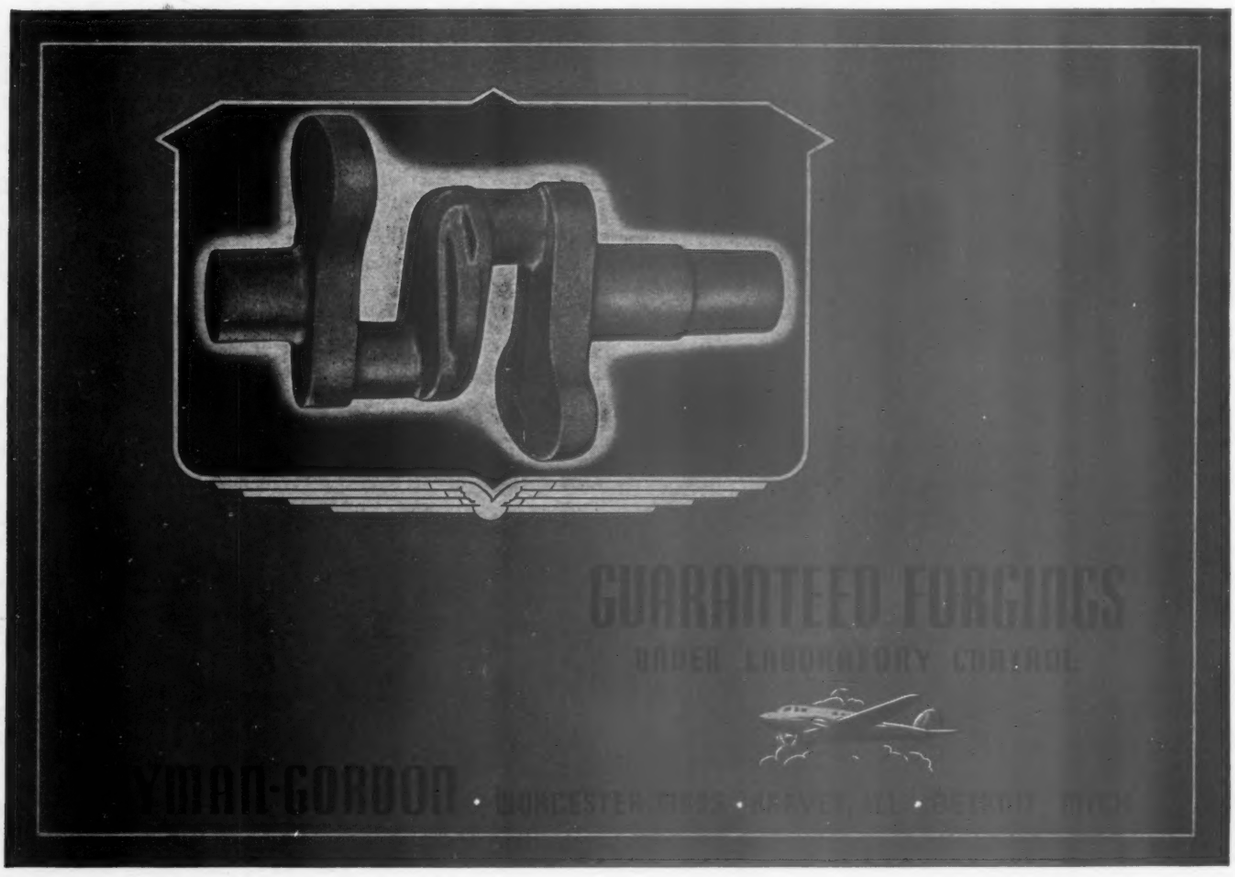
Reports have also come in that the Danish Line, DDL, has joined the Swedish ABA in services to and from Berlin, which were reopened recently. The Danish line operates a number of German four-engined "Condors," while the ABA is a well-known user of Douglas equipment.

Most important news for South America was the recent purchase (pending CAB approval) of the Transportes Aereos Centro Americanos by the American Export Airlines, which was announced in New York around the end of September. TACA is a pioneering line in Central America, specializing in freight hauling to out of the way places, and carrying more freight than any other airline in the world. They operate a curious mixture of old and modern equipment, Fords, Fokkers and Lockheed 14s, over all countries between British Honduras and Costa Rica, and for some time now have been attempting to obtain permission to extend their services to Panama.

It is in line with this country's hemisphere defense policies to reject applications for lines in or out of the Southern United States or U.S. possessions by foreign airlines. The TACA, owned and started from scratch by Lowell Yerex, World War ace from Australia, is an English company, which naturally made the permission for the Canal Zone more or less problematic. This obstacle was removed by the purchase by Export, and it can well be expected that one of TACA's first actions will be to obtain permission to extend their services to Panama.

With the invasion of Holland, and the start of the "total war," the services of the Dutch Airlines to and from Trinidad were suspended, due to the fact that censorship regulations were not being adhered to. Indications now are that these services probably will be resumed the end of this year or early in 1941.

In the meantime, the Government of Trinidad seems to be considering the possibility of starting a British line to connect this island with the other British possessions, especially Barbados, Tobago and the British Antilles, which at the moment, due to lack of ship facilities, are more or less disconnected. Though nothing further is available, it can be safely assumed that this new line will be British, as it is a British policy to have their colonies served by an English company.



floor space from 30,000 to 90,000 sq.ft.

Adel Precision Products Corp. has started construction on a new air conditioned plant at Burbank, Cal., costing $250,000.

Vultee Aircraft Inc., recently took over Stinson Division of Aviation Manufacturing Corp., has completed new factory at Nashville and is planning further expansion. At this plant the company is increasing space from 190,000 sq.ft. to 618,000 sq.ft. at a cost for building and machinery of $4,000,000. There are now more than 5,500 men on the payroll and this figure is expected to exceed 18,000 by July, 1941.

With its total backlog boosted to more than $90,000,000 by granting of a War Department contract of $29,494,633, Vultee, is rushing a huge expansion program to bring its Downey plant up to a total floor area of 1,225,000 sq.ft. from its present area of 465,000 sq.ft.

Northrop Aircraft, its 200,000-sq.ft. plant at Hawthorne, Calif., only completed last February, has already started an expansion program which will bring floor space to 500,000 square feet through a million dollar building project financed entirely by the company without additional financing or borrowing. La Motte T. Cohu, chairman of the board, announced that the general contract, requiring erection of 800 tons of steel, has been let to E. S. McKittrick Co. The new construction includes a main plant building of 200,000 sq.ft., a warehouse of 22,400 sq.ft.; 21,000 sq.ft. more space for the hammer shop; a personnel building of 2,400 sq.ft., and 40,500 sq.ft. of mezzanine subassembly floor area. The company already has in operation a complete research laboratory and wind tunnel.

Aeronca will enlarge its factory by 35%, increasing its final assembly dept. by approximately 20,000 sq.ft.

Lockheed Aircraft Co., is spending $5,500,000 of its own money for expansion of its Vega Airplane Co. plant in California.

Bellanca Aircraft Corp. is reported planning to spend $1,000,000 for a new plant at Yonkers, N. Y.; would build speed boats in addition to airplanes.

Fairchild Aviation has tripled space of engine plant at Hagerstown, Md., and is said to be negotiating with RFC.

Beech Aircraft Corp., is building a new plant at Wichita.

Bell Aircraft Corp. is building a $1,500,000 assembly plant at Niagara Falls, to cover about 240,000 sq.ft. and employ 3,000 persons.

Brewster Aeronautical Corp., is enlarging plants at Newark, N. J., and on Long Island.

Grumman Aircraft and Engineering, Bethpage, Long Island, is expanding to fill a $7,000,000 order for Navy bombers. Additional space of 400,000 sq.ft. costing $2,000,000 and employing about 4000 men on one shift will be financed by the RFC.

Consolidated Aircraft Corporation has just dedicated 82% expansion at cost of $1,050,000. Will jump from 9,600 men now, to 15,000 by Christmas.

Aviation Manufacturing Corp., spending $1,500,000 for a 4-year expansion program.

Republic has initiated an expansion program that will more than quadruple its present plant, adding about 1,000,000 sq.ft. at a cost of $9,000,000. It is hoped to have the plant in production by Jan. 1, turning out four or more P-44 pursuit ships per day.

North American's new $7,000,000 plant at Dallas, on which work started late in September, is scheduled for completion in March. Covering a million square feet, it will be windowless and air conditioned. It will be devoted to production of advanced trainers. Meanwhile the Inglewood, Calif., plant, under enlargement since June, will have a million-foot area by year end.

Taylorcraft has under way a $200,000 expansion which will increase area from the present 22,600 sq.ft. to about 72,000, and two-shift capacity from 1,300 to 3,500 per year. Factory and office buildings are to be ready for occupancy in mid-December.

Aeronca, which moved into a new plant at Middletown, Ohio, in June, has already started a $75,000 addition which will double the present output of 125 planes per month.

Lear Avia plans by early next year to have quadrupled its Dayton plant capacity for aviation radio products. Lear will add a second story to its present plant and then construct a new building twice the size of the present.

Bendix Aviation Co., manufacturer of accessories—starters, brakes—has a commitment for $17,000,000 RFC money for plant extension and machinery.

Fleetwings, Inc., expected to spend $1,000,000 for a plant at Dallas, Texas.

Bell has started construction of a $1,050,000 assembly building at the Niagara Falls, N. Y., airport. Production at the new 240,000-sq.ft. plant will supplement assembly at the existing Elmwood Ave. plant. It is planned also to expand the latter plant from its present 300,000 ft. to 435,000 ft. British production will be concentrated at Buffalo, while all U.S. fighters will be assembled at Niagara Falls.

Recent Awards

Navy Department

Curtiss-Wright Corp., Robertson, Mo., $3,674,566 for airplanes.

United States Gauge Co., New York City, $42,600 for air speed indicators.

Breeze Corporations Inc., Newark, N. J., $355,805 for aircraft flowmeters.

Square D Co., Elmhurst, N. Y., $194,616 for climb indicators.

Bendix Aviation Corp., Bendix, N. J., $279,225 for climb indicators.

Square D Co., Elmhurst, N. Y., $85,811 for aircraft compasses.

United Aircraft Corp., East Hartford, Conn., $34,837 for propellers, blades.

Bendix Aviation Corp., Bendix, N. J., $201,762 for starters.

War Department

Wright Aeronautical Corp., Paterson, N. J., $81,569,140 for airplane engines.

Fairchild Engine & Airplane Corp., Farmingdale, N. Y., $196,725 for airplane engines.

United Aircraft Corp., East Hartford, Conn., $104,832 for maintenance parts.

McCauley Steel Products Co., Dayton, Ohio, $308,880 for propeller assemblies.

Bendix Aircraft Corp., Bendix, N. J., $101,992 for signal assemblies.

Air Cruisers Inc., Clifton, N. J., $252,797 for cylinder assemblies.

Independent Eng. Co., Inc., O'Fallon, Illinois, $145,800 for cylinder assemblies.

Walter Kidde & Co., Inc., New York City, $127,907 for cylinder assemblies.

The Aro Equipment Corp., Bryan, Ohio, $100,672 for propeller hub assemblies.

Boeing Airplane Co., Wichita, Kan. $305,256 for maintenance parts.

Curtiss-Wright Corp., Clifton, N. J., $203,650 for propeller assemblies.

Wright Aeronautical Corp., Paterson, N. J., $1,042,866 for maintenance parts.

North American Aviation, Inc., Inglewood, Calif., $37,770,981 for airplanes.

Douglas Aircraft Co. Inc., Santa Monica, Calif., $141,320,610 for airplanes.

Douglas Aircraft Co. Inc., Santa Monica, Calif., $37,462,121 for airplanes.

Glenn L. Martin Co., Baltimore, Md., $99,641,880 for airplanes.

Curtiss-Wright Corp., Robertson, Mo., $45,646,882 for airplanes.

Curtiss-Wright Corp., Buffalo, N. Y., $48,514,819 for airplanes.

North American Aviation, Inc., Inglewood, Calif., $72,857 for airplanes.

Continental Motors Corp., Muskegon, Mich., $4,727,542 for airplane engines.

Ryan Aeronautical Corp., San Diego, Calif., $5,355,087 for airplanes.

Fairchild Aircraft Corp., Hagerstown, Md., $6,672,200 for airplanes.

Thompson Products, Inc., Cleveland, Ohio, $105,400 for fuel and vacuum pumps.

Pump Eng. Service Corp., Cleveland, Ohio, $623,895 for fuel and vacuum pumps.

Chandler-Evans Corp., South Meriden, Conn., $106,560 for fuel and vacuum pumps.

Leece-Neville Co., Cleveland, Ohio, $934,389 for generator and regulator assemblies.

Bendix Aviation Corp., Bendix, N. J., $859,293 for generator and regulator assemblies.

Wright Aeronautical Corp., Paterson, N. J., $6,829,144 for airplane engines.

Beech Aircraft Corp., Wichita, Kan., $13,115,138 for training planes & spare parts.

In The Air

At least three billion dollars of bank credit is available to finance private plant expansion for defense under the bankable contract plan (AVIATION, October, page 80), a test survey by the Federal Reserve System indicates.

Interstate's new light airplane, the Cadet, has got into production on a schedule that requires the Los Angeles plant to turn out 900 ships during its first year. November production is set at a two-a-day rate. Interstate continues its regular parts production.

the "eagle" looks ahead...

With the greater speeds and more grueling tactical requirements of planes built for today's National Defense Program, Army and Navy specifications for Control Cord become increasingly severe.

By building Control Cord to meet these new specifications, Roebling maintains its place as standard equipment on a large percentage of planes built for this service.

And to help the Aviation Industry meet every new challenge — Roebling, through its program of planned Research, will continue to meet specifications for "tomorrow's" Control Cord.

JOHN A. ROEBLING'S SONS CO., TRENTON, NEW JERSEY

Roebling Aircraft Products are available either tinned, galvanized or Stainless Steel, in regular or preformed constructions

KEEPING PACE WITH AN INDUSTRY WHOSE WATCHWORD IS PROGRESS

THE BOARD OF DIRECTORS of American Export Airlines has announced the election of Durston G. Richardson (l.) as vice president in charge of operations, and Dudley Phelps King Wood as vice president. Mr. Richardson served as flying officer during the war and for ten years has been in charge of airline operations covering Central and South America. Mr. Wood is experienced in the management of American-owned companies abroad.

HARVEY C. TAFE was appointed general manager of Vultee Aircraft's new Nashville Division. He was formerly associated with North American Aviation and with the Guggenheim Foundation.

HERSCHEL R. SNODGRASS, chosen by committee of chief meteorologists of the airlines, receives Air Transport Association's Fellowship in Meteorology,—$500 yearly donated by U.S. airlines.

CHICAGO & SOUTHERN'S new chief stewardess, Gladys Pino, has seen active service since May 1, and has been flying an average of 4,000 miles a week between New Orleans and Chicago.

IN WORLD WAR I, J. H. Marks supervised production of Packard Motor Car Co.'s Liberty motors. Now named vice president, he takes over the company's Rolls Royce engine project.

W. B. Ehlers

BECKWITH HAVENS has just been elected president of The Early Birds (fliers who piloted prior to 1916), and AVIATION'S picture files show how he looked when he became eligible.

SAE NOMINEE for president for 1941 is A. T. Colwell, vice president, Thompson Products. Nominee for treasurer is David Beecroft, Bendix Products Division, Bendix Aviation Corp.

ROY McGUIRE, formerly with Lear Avia, is president of Instrument Design, Inc., licensee of the deFlorez patents for directional control. The device will be known as the McGuire Safety Pilot.

LOWERY L. BRABHAM, recently resigned from the Air Corps to take over as test pilot for Republic Aviation Corp., is conducting flight tests of a new Republic design for export.

Harris & Ewing

ELECTED to continue as president of the National Aeronautic Association is Capt. Gill Robb Wilson (l), while Col. G. deFreest Larner, as executive vice president and secretary, remains in active direction at Washington headquarters. Three new vice presidents chosen were Max C. Fleischmann of Nevada, Harry Coffey of Oregon, and William R. Enyart of New York, the latter NAA's former secretary.

Bachrach

CONTINUED EXPANSION in Kellett Autogiro Corp.'s subcontracting activities necessitated the transfer of Adolph C. Falk from chief engineer to factory manager, in full charge of production.

APPOINTMENT of Anthony Easton as Chief Engineer of the Thos. L. Siebenthaler Manufacturing Company, Kansas City, Missouri, has been announced by Preston B. Tanner, general manager.

EDWARD A. TAPPE, manager of the passenger relations department of TWA, Kansas City, has been appointed acting chairman of the Aviation Committee of the U. S. Jr. Chamber of Commerce.

His may be a discovery that changes aviation

Just a child playing with a toy. But even now his mind is in the clouds—his tin "airplane" carrying him over the housetops to distant lands.

And just as he gives free play to his childish imagination, so do the practical men of aviation keep an open mind as they look toward the future. For in the mind of the aviation engineer, today's performance is only something to be surpassed tomorrow.

How? That comes down to specific problems of design, propellers, controls and engines. And it is in the field of engine and fuel development that the Ethyl engineers are working in close cooperation with aviation technicians.

A program of continuous research has developed files of useful data. Some of the information is being applied to today's problems. Other facts will be of value in the future, facts that may possibly aid an aviation man who today is practicing "landings" on his playroom floor.

ETHYL GASOLINE CORPORATION, *manufacturer of anti-knock fluids used by oil companies to improve gasoline*

Plastics Award for Aircraft Construction

Several newly designed bombers and fighters are now using Laminated Phenol Fabric construction for trim tabs on aileron and tail surfaces. These tabs are said to be lighter, stronger and more rigid than the metal parts used previously. Likewise they tend to facilitate mass production and reduce manufacturing costs. The Taylor Fibre Company, Norristown, Penna., is producing these airplane tabs to various manufacturers' specifications.

This company recently won the Modern Plastics Magazine's highest award in the Transportation group for having supplied the material for this unique product.

A plaque for having used these tabs was given the Glenn L. Martin Company, Baltimore, Md. Also working on the development of these tabs was the Formica Insulation Company of Cincinnati.

Designed for use on ailerons, elevators, and rudders, these plastic tabs are to be used in place of metal or fabric parts and combine valuable features of lightness and strength. The laminated phenolic fabric base structure weighs appreciably less than aluminum and on strength tests has far exceeded specifications established for metallic tabs. The smooth uninterrupted surface of the plastic tab offers many advantages over a metal tab having projecting rivet heads or overlapping seams. Moisture does not affect the material and it is not subject to corrosion.

The flat longitudinal strengthening bulkhead inside the tab increases very greatly the rigidity of the exterior surfaces. This bulkhead also provides an ideal attachment and supporting surface for the hinges, control horns and other similar parts. The interior bulkhead is made integral with the exterior part of the tab so that a homogeneous structure of great strength is produced.

Eliminates Operations

The use of plastic eliminates many operations formerly necessary when metal was employed. For instance, the outer skin and longitudinal interior support are fabricated in one piece by a single application of heat and externally applied pressure. Formerly it was necessary to cut the metal, bend it to form and hold it together by rivets.

An honorable mention went to The Aeronautical Corporation, Middletown, Ohio, for their Aeronca instrument panel. The panel consists of five parts: the formed aluminum-sub-panel on which the instruments are mounted, a center Monsanto polystyrene plastic panel which serves as a finished cover frame for the instruments, and a plastic control panel which is located directly below the center panel on which are mounted the various controls and switches. On each side of these panels are smaller plastic panels.

With the increasing number of private owners of airplanes it has been necessary to design attractive interiors along the lines of our modern automobiles. The instrument panel is not only a vitally important part, but is now decoratively executed as well.

Bomber Seat

Few people outside of those in the services ever get a chance to look inside a bomber. But if they happened to stick their head inside one of the latest Martin Bombers they would see a pilot's seat like the one above.

Built by the Warren McArthur Corp. of New York City, it is made of aluminum alloy with an anodized black finish. The design load is 2,400 lb. on the extended position of the seat in the reclining position, and it weighs 32 lb. 9 oz. It is built for a load of 1,600 lb. on the safety belt bracket at a 30 deg. angle from the floor, and 1,200 lb. horizontal pressure against the back 14 in. above the reference point. The seat and back can be adjusted to reclining positions and the seat drops 10 deg. in the rear and the back adjusts to a 127 deg. horizontal angle.

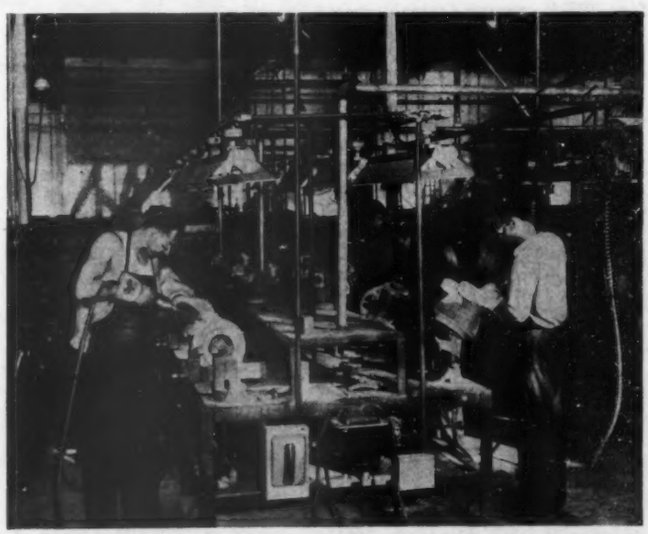
In the airplane the seat is mounted on tracks with a track lock lever mounted on the truck channels. The vertical motion is 7 in. with locking positions in ½ in. spacing. Parachute pans are provided for both seat and back parachute and the seat arms are retractable for egress and entrance to the chair.

Douglas B-19 Data

Additional details on design, construction, and performance of the great Douglas B-19 bomber are now available. Scheduled to be ready for flight testing late this year, the big bomber now has a crew of 500 engineers, technicians, and mechanics working in three eight-hour shifts to apply the finishing touches to this one airplane. Construction has been underway for nearly four years. Some 9,000 individual drawings were made during this time, sufficient to cover 4 acres. Nearly 3,000,000 rivets have been driven and 10 miles of electrical wiring and 2 miles of control cable installed. Engineering time on this project will total more than 700,000 man-hours, construction time 1,250,000 man-hours, and test and research 42,500 man-hours. When taken over by the U.S. Army Air Corps the B-19 will serve as a flying laboratory for assembling structural and tactical information. Design data released includes: wing spread —212 ft.; length overall—132 ft., weight empty—83,253 lb.; normal gross weight—140,000 lb.; provisional gross weight—164,000 lb. Top speed 210 m.p.h., cruising 186 m.p.h., landing 69 m.p.h., range 7,500 miles, service ceiling 22,000 feet, fuel capacity 11,000 gallons, crew 10 men, bomb load 18 ton.

Wide World

A VARIABLE-PITCH PROPELLER has been designed for light planes by H. H. Roby, of Wichita. New prop, shown above with Mr. Roby, permits an engine to reach maximum power on take-off, and is claimed to give a 50-hp. engine the take-off power of a 65-hp. engine using an ordinary propeller.



Acme

LINE PRODUCTION in an aircraft engine foundry is something new. At plant No. 3 of Wright Aeronautical Corp. in Paterson, N. J., these men are removing excess metal from castings for cylinders. At right a worker is grinding the surfaces of a cylinder head.

American Export Lines Get TACA Air System
Pan American Finances Guatemalan Competition

American Export Airlines, which has been granted a CAB certificate to fly the Atlantic with mail, passengers and cargo, has acquired TACA (Transportes Aeroes Centros Americanos), an air system operating throughout Central America, with 52 planes, carrying the enormous volume of 30,000,000 lb. of freight this year. TACA has 235 airports, of which 125 are scheduled stops, operates 40 radio stations, and has 118 traffic agencies.

AEA's acquisition of TACA is an important strategic move in the American flag foreign air system, and it figures strongly in the hemisphere defense program. Undoubtedly AEA will use TACA as a springboard into Pan American's Latin-American territory. And, TACA is a competitor of PAA in the *Central* region. But PAA, not to be outdone, has financed a Guatemalan airline to compete with TACA. This setup has all the makings of a battle royal between the two transport giants.

Meanwhile, Congress has stricken from an appropriation bill $500,000 which was intended to pay AEA for carrying transatlantic mail, but the company is not ready to start operations anyway, and has confidence that the next Congress will award the money.

MAJOR AL WILLIAMS, left, being greeted at the Chicago airport by J. A. Herlihy, executive vice president of United Air Lines. Al went out to address the aeronautical meeting of the SAE.

CANADIAN AIRWAYS, LTD., is now flying these all-metal Beechcrafts on its Maritimes Division. Ships are powered with two Wright Whirlwinds of 350 hp. each; can cruise with a full load at over 200 m.p.h.

Plan Aviation Parks

Aviation recreational areas should be planned ahead by all cities and towns in the opinion of NAA officers, and Robert Hinckley, Assistant Secretary of Commerce for aviation, writes a letter to NAA, saying he agrees. Flying is going to be more a part of life's routine pleasures than most people realize.

Mail Rate Increase Denied

Congress flatly refused a request by the Post Office Department for money to pay mail rate increases set by CAB for TWA routes, which may force the airline to sue in the U.S. Court of Claims. All requests for air mail payments on new routes were granted.

Although the Senate Appropriations Committee, which was responsible for the rejection, admitted that CAB had full authority to determine the rate and to decide on what date it should become effective, members appeared to feel that since TWA's original bids were "astronomical", the line should be made to carry the mails at the old rate as long as possible. Thus it took issue with CAB's decision setting the date when applications were filed, rather than date of findings, as the effective date.

Committee hearings clearly indicated the committee prefers punitive rather than economic considerations as a basis for rate-fixing. CAB contends its actions are upheld by a U.S. Supreme Court decision in a parallel ICC railroad rate case.

TWA Star Gazers

First domestic airline to start training on celestial navigation is TWA. Long-range flying, both civil and military, is coming. In over-weather flying, you can always get a bead on sun or stars. Flying long distances without the usual aids to flight would be immensely valuable in military operations. TWA's system will be an aeronautical version of celestial navigation at sea. The trick is done with a star, a sextant, a chronometer, and an astronomical timetable. Knowledge of sky navigation is not now required of airline pilots, but it may be. More book learnin' for you boys.

AIR TRANSPORT INDICATOR

October 1, 1940

156.9

Which is the ratio of passenger-miles reported by the Air Transport Association for all domestic lines for September, 1940, to the figure for September, 1939. Total for the indicator has fallen back slightly after its gain last month. For the first seven months of 1940 traffic stood at 768,497,820, revenue passenger miles—up 56.9 per cent over September, 1939.

See Finance page for individual companies' traffic figures.

Air Cargo Report

This is the dope on air freight. The airlines don't like any three-way schemes involving the railroads, express services, and themselves. They feel that air cargo is their own field, and they want to handle it when they can. But repeated pressure for express and freight service is forcing them to act sooner than they otherwise would. They would like to stick to passengers and mail for a while yet. Nevertheless, they have gone to work on a survey to end all surveys of potential cargo, rates, how to handle it. They say they believe a big volume of stuff would be available at rates acceptable to the public. Next thing will be announcement of airlines' plans. When they could get equipment and set up an adequate ground pick-up-and-delivery is unpredictable.

Two New Control Centers

Two additional airline traffic control centers are being set up by the Civil Aeronautics Administration, at Cincinnati and at Seattle, bringing total stations on the U.S. airway system to fourteen. Present plans call for nine more, for which there is now no money available.

Principal duties of traffic control centers is to supervise aircraft movements in regions under their jurisdiction, particularly to stipulate the altitude at which trips are to be flown, and to manage all movements so as to avoid congestion and hazard. Cincinnati will control 1,090 miles of airways, Seattle 1,060 miles.

UAL Injection System

Installation of injection carburetors on equipment of U.S. airlines would save them $500,000 annually, according to an estimate by United Air Lines, based on company's experience with Bendix-Stromberg injectors on its coast-to-coast liners.

J. A. Herlihy, UAL executive, says the carburetors save about 10 percent in fuel, to which is added increased payload because less fuel is carried. He figures these two items add up to a $100 saving on a

typical New York-Chicago trip. On a coast-to-coast trip the saving would be about $325.

The carburetor sprays fuel directly into the induction system. It is self-compensating for power, altitude, and temperature, equalizing efficiency at different altitudes and temperatures; reduces likelihood of ice in the throttle valve.

Airline Doings

Penn-Central inaugurates service between Norfolk, Va., and Knoxville, Tenn., Nov. 1. CAB granted certificate on the 500-mile route. New 1941 Douglas liners were placed, Oct. 15, on Pittsburgh-Buffalo, Buffalo-Washington, and Pittsburgh-Baltimore. This puts DCs on all lines except Detroit-Sault St. Marie. New service started on Grand Rapids-Traverse City, Mich., Oct. 9; operates between May 1 and Oct. 1. PCA sold ten Boeing 247Ds to a dealer for delivery to Canada.

Trans-Canada Air Lines had its heaviest traffic increase, since operations began, in August; gained 2,000 passengers over previous month, 5,000 lb. of mail and 3,500 lb. of express. In the first eight months of this year, TCA carried 34,000 passengers, three times over same period last year. New Lodestars to be delivered to TCA this fall will carry automatic radio compasses.

United Air Lines has placed an order for 100 Bendix automatic direction finders to equip its entire fleet, including DC-4s which will be delivered next year. During the first three-quarters of 1940, company carried as much passenger traffic as in the full year 1939. UAL flew about the same revenue passenger-mileage in each period: 149,000,000. Traffic shows a 58 percent increase over the first three quarters of last year.

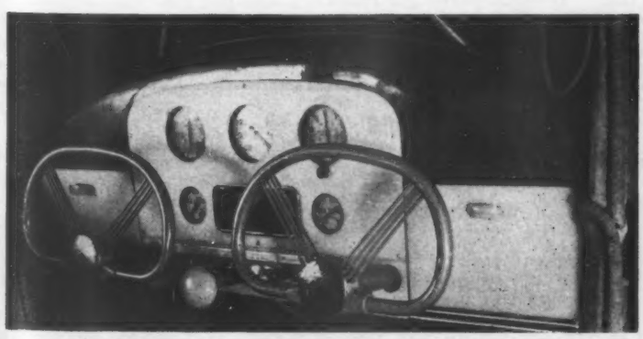
Northwest Airlines applied for a CAB certificate to operate a new service between Twin Cities and Chicago, via four Wisconsin cities, reaching populations totaling 4,853,900. Ten-passenger Lockheed Electras will be used if route is approved. Military planes took Tacoma airport away from NA, but company provides taxi to Seattle field. Evidently the Pullman Co. didn't use up all the nifty names; Northwest has tagged seven of its flights: such as "The Starlighter," "The Sunlighter."

Transcontinental and Western Air sold its Northrop strato experimental plane to an oil company. Organized "Stratoliner Club" to give joiners a field day. Applied to CAB for a stop at Columbia, Mo. Applied for a Washington, D. C.-Dayton, Ohio, route.

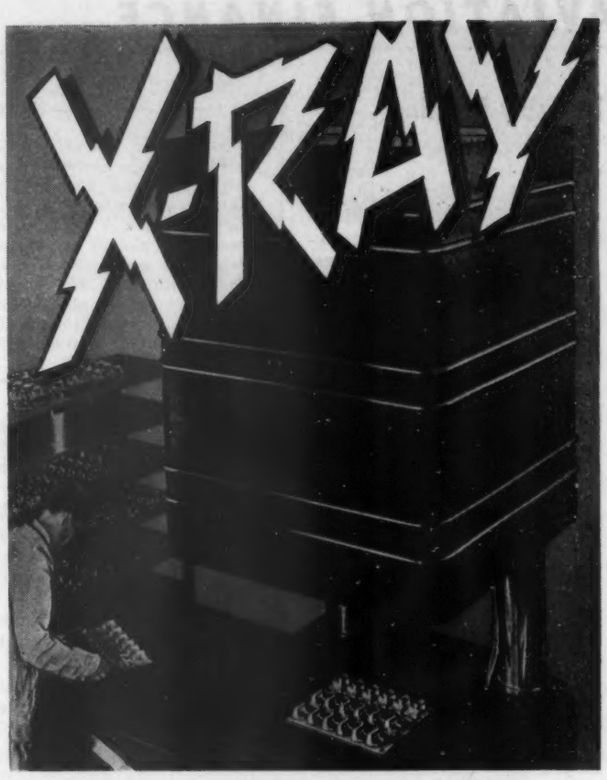
Braniff Airways traffic trends for the first eight months of 1940 show doubled figures over the same period last year. Houston Texas, got an additional round trip to San Antonio and an extra round trip to Corpus Christi, effective Oct. 15. Two new services between Oklahoma City, Amarillo and the West Coast commenced Nov. 1. The trip connects with TWA.

American Airlines added a new round trip between Cleveland and Cincinnati via Indianapolis, and another between same termini direct, using DC3s. NY-LA Skysleeper is running double-sections.

Eastern Air Lines' new DC3s for N.Y.—Florida flew from Winslow, Ariz., 1,920 miles non-stop. Powered with new type 1,200 hp. Wright Cyclones, one of them, flown by Capt. Fred Davis, made 2.65 miles per gal. of fuel for the trip.



A new plastic, Monsanto polystyrene, is used for the instrument board of the Aeronca Super Chief. This panel is believed to be the largest injection molding of polystyrene.



PUTS "Metal Failure" ON THE SPOT

Built at a cost of $50,000, this giant X-Ray machine is used to test and analyze the vital metals built into Lockheed airplanes. No hidden flaw, no weakness, can escape its searching analysis.

Under this most severe of all tests, AMPCO METAL fully meets rigid aviation specifications for parts subjected to extreme wear, impact, stress and fatigue.

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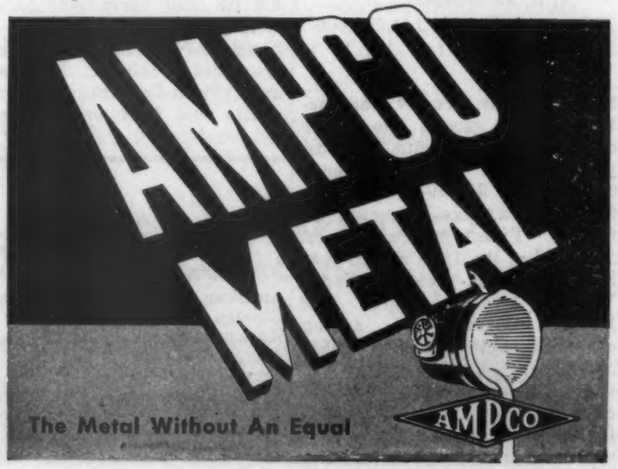

AVIATION FINANCE

Industry Backlog

Unfilled orders of the aircraft industry are now in excess of $3,000,000,000, an increase of nearly one billion dollars in the past month. A year ago the industry was boasting of a $400,000,000 record backlog—the greater portion of which consisted of British and French war orders. While the Army's aircraft purchasing program is completed, less than half of the 7,000 planes authorized for the Navy have been contracted, although negotiations for the remainder are under way. Brewster, Fairchild and Grumman are among those who are expected to share in the new Navy orders. Meanwhile Great Britain is negotiating repeat orders with several companies. The following table gives the latest approximate unfilled orders of 23 prominent producers of planes or aircraft engines.

Allison	$60,000,000
Aviation Corp.	20,000,000
Beech	22,000,000
Bell	60,000,000
Boeing	190,000,000
Brewster	60,000,000
Cessna	11,000,000
Consolidated	220,000,000
Continental	15,000,000
Curtiss-Wright	550,000,000
Douglas	400,000,000
Fairchild	15,000,000
Ford	9,000,000
Grumman	20,000,000
Lockheed	225,000,000
Martin	220,000,000
North American	225,000,000
Northrop	20,000,000
Packard	187,000,000
Republic	65,000,000
Ryan	10,000,000
United Airc.	450,000,000
Vultee	90,000,000
	$3,144,000,000

Several of the aircraft manufacturers will escape the newly enacted excess profits tax this year as their fiscal year ends before Dec. 31, 1940, the date the new taxation becomes effective. Piper Aircraft Corp. terminates its 1940 fiscal year Sept. 30 while Aviation Corp., Vultee Aircraft Corp. and Douglas Aircraft Co., among others, conclude their financial year on Nov. 30. For these companies the tax will be effective one year longer than for those whose fiscal year ends with the calendar year but they stand to benefit if their 1940 earnings are sufficiently good to lift their four-year average earnings. Because of the high percentage most companies are earning on their invested capital, they will use the four-year average method of computing their excess profits tax liability.

By Raymond Hoadley

About fifteen aircraft companies which are working on new Army orders will sign contracts shortly calling for expansion of their plants with government financial aid. Congress appropriated $273,000,000 for this purpose—to finance additional construction believed necessary to reach a 1942 production goal of 36,000 planes a year. Meanwhile aircraft employment has jumped 300 percent in the past two years and shipments are at record levels this fall. Earnings of the aircrafts in 1940 will be heavily penalized by excess profits taxes but will top all previous years due to the almost perpendicular increase in sales. Year-end dividend payments should be larger and more numerous than in 1939.

Hughes Tool Co., of Houston, Texas, (Howard Hughes) which has been active for many months in the acquisition of TWA, Inc. common stock, purchased an additional 12,600 shares in August, bringing holdings to 371,950 shares or 40 percent of the airline's stock.

Despite the fact that they are enjoying record earnings, the air lines will not be affected by the excess profits tax law this year other than for the 5 percent increase in the normal tax rate which applies to all corporations. Under the new law the air carriers do not become subject to the excess profits tax until their earnings exceed their mail revenues. While their earnings this year will be substantially larger than in 1939, indications are that in all cases they will still be less than their mail revenues.

The air lines are receiving another break through the sale of old transports to agents for the British and Canadian governments. Braniff, Chicago & Southern, Continental, Eastern, Mid-Continent, Northwest and Penn-Central have recently sold from one to ten of these planes at prices which yield substantial gains over the present book value of these units. The planes will be used in training military pilots in the operation of multi-engine equipment.

American Airlines is increasing its capitalization by the creation of an issue of 100,000 shares of preferred stock. In order to finance the purchase of new equipment it is expected that 50,000 shares of the new preferred issue will be offered to the public shortly by an underwriting group consisting of Emanuel & Co., Kidder Peabody & Co. and Lehman Bros., all of New York.

Lockheed will have the capacity to turn out $75,000,000 worth of airplanes annually upon completion of its expansion program next January. Sales in the first six months of 1940 totaled $19,000,000 and will run somewhat higher for the current six months. By the end of the year Lockheed should be producing four planes daily, three times the present rate, and company officials believe the enlarged plant can turn out 200 planes a month later on.

Passenger air traffic for the first nine months of 1940 showed a gain of 60 percent over the corresponding 1939 period and totaled approximately 775 million revenue-passenger-miles, as against 481 million in all of 1939, the record year.

As a result of these large gains in passenger traffic, the domestic air lines probably earned twice as much in the first nine months of 1940 as they did a year ago. And the financial statements for the three months ended Sept. 30, 1940, are expected to show the largest quarterly profits yet experienced in this industry.

Bendix Aviation Corp. recently had $69,000,000 in unfilled orders on its books, as compared with approximately $45,000,000 on June 30 and $37,000,000 at the 1939 year end. Earnings this year probably will be among the best in the company's history.

Fairchild Engine & Airplane Corp. operated at a loss of $24,540 for the six months ended June 30, 1940, but had a net profit of $272,077 for the twelve months ended on the same date. The 1940 first half deficit reflected large expenses entailed in preparations for production of Army training planes. The benefits of this advance work will be felt early next year as the company has sufficient government orders to require capacity operations through 1941.

Grumman Aircraft shipments in the three months to Sept. 30 totaled $3,779,619 while new business amounted to $14,807,000. Ten planes are turned out weekly on one shift and upon completion of the new windowless plant output will be tripled.

Vultee Aircraft earned a net profit of $277,000 in the three months ended Aug. 31, 1940, sufficient to reduce its nine months loss to $58,000. Net sales in the August quarter were $2,116,000, as against $738,000 for the preceding six months.

President Courtlandt S. Gross of Vega Airplane Co. discloses

With the Airlines

Company	Revenue Passenger-Miles* September 1940	1939	% Gain	9 Months 1940	1939	% Gain	Revenue Passengers September 1940	1939	% Gain	9 Months 1940	1939	% Gain
American	#31,254	20,085	55	x 196,317	123,221	59	#90,279	54,122	69	538,324	319,262	67
Chicago & Southern	1,683	895	87	11,467	6,466	77	4,555	2,277	100	29,911	16,361	80
Eastern	12,335	8,044	54	115,199	73,081	57	31,000	21,185	56	247,874	172,596	43
Northwest	5,891	4,192	40	39,742	25,226	57	12,283	8,687	41	94,115	63,540	48
Penn-Central	3,714	2,221	67	28,030	15,423	82	21,571	13,155	64	157,378	88,867	77
TWA	#18,122	10,231	77	x 96,489	59,686	61	#40,437	20,731	95	x 204,245	118,356	72
United	25,085	16,880	48	170,983	109,010	56	#59,242	32,720	81	x 293,926	176,295	66
Western Air	1,739	1,169	48	12,156	8,217	48	#6,640	3,692	79	x 31,086	18,995	67

* (1,000 — Omitted) x — 8 Months #August.

to stockholders the company's intention to develop products which will place it in a position to capitalize on the eventual demand for small commercial airplanes and the small private or family plane. Events of the past year, he declares, have served to strengthen the Vega management's conviction as to the ultimate size of this market.

Here And There . . . Aeronautical Corp. of America has unfilled orders totaling over 500 airplanes and expects to increase output to around 250 planes monthly when new factory additions are completed . . . The assets of Paramount Aircraft Products Inc. have been purchased by Felt & Co. and Allen & Co. as a first step in the formation of a new aircraft parts company . . . Iron Fireman Co. will machine parts for Boeing at the former's Portland, Ore., plant . . . Kellett Autogiro Corp. has aircraft parts orders aggregating $702,000, as against $275,000 a year ago . . . Taylorcraft's eight months sales jumped 183 percent above the similar 1939 period . . . Hardman Aircraft Products, organized a year ago, has completed a new plant and employs 200 men . . . Bell Aircraft will report a small profit this year with prospects of larger earnings in 1941 when production will be better than 30 planes a month . . . Piper Aircraft's backlog now runs in excess of $1,000,000 . . . Bath Iron Works Co. has made provision for the future manufacture of aircraft in its new plant addition at East Brunswick, Me. . . . A $36,000,000 contract to North American Aviation completed the current Army purchasing program . . . Continental Motors is turning out twenty light plane engines a day . . . The Ercoupe factory has revised upwards its production schedules and now plans to build 200 planes by March 1, 1941 . . . Deliveries of Curtiss-Wright and United Aircraft are running between $12,000,000 and $15,000,000 a month . . . Fairchild Aviation Corp. reports unfilled orders were $5,343,000 as of Aug. 31, 1940, as compared with $1,616,000 a year ago.

Kinner Backlog

Kinner Motors, Inc., Glendale, Calif., is reported benefiting from current large military orders for primary trainers. As of Oct. 1, the Kinner backlog was set at $700,000, a new all-time high despite recent deliveries at the rate of more than $150,000 per month. Deliveries on a Canadian order for 509 engines of 125 hp. each are reported more than half completed. Recent reports have indicated flight tests are under way on a Kinner powered Ryan military trainer.

Army Buys Ryans

Closing of a $5,355,087 contract with the Army Air Corps for production of primary trainers has more than doubled the backlog of the Ryan Aeronautical Co., San Diego, bringing total unfilled business to about $10,000,000.

Air Industry Gets Most Defense Loans

One of the curious byproducts of defense is that RFC has gone into the business of financing purchase of light planes. Of 97 defense loans made during the first three months of the program, 46 were to flying services to permit purchase of training planes to be used in the CAA program. Nearly all were small, about $7,000, and the total was $500,000.

All the loans together amounted to $250,000,000, of which all but about $31,000,000 involved some phase of aviation. Largest were $12,300,000 to Consolidated, $18,588,000 to Bendix Aviation, $3,500,000 to Grumman, $51,160,000 to Curtiss-Wright, $92,000,000 to Wright Aeronautical, and $10,500,000 to Boeing.

NA Goes to Dallas

With new military orders bringing the backlog of North American Aviation, Inc. business to a total of more than $225,000,000, J. H. Kindelberger, president, has announced immediate construction of a plant in Dallas. It will be windowless, air conditioned, one million sq. ft. of floor space. Costing $7,000,000, the new plant will accommodate a peak personnel of 12,000 persons, compared with 10,000 at the Los Angeles plant.

Kindelberger also revealed that $3,500,000 is being spent on additions to the Los Angeles factory to bring floor area to one million sq.ft. The Dallas plant is under separate administration and will be known as North American Aviation, Inc., of Texas. Production in the Texas plant will be concentrated on the Type AT-6A advanced trainers for the U.S. Army Air Corps. Supervision of the Dallas plant will be in the hands of Alexander T. Burton, division manager; Kenneth Bowen, production manager: James Rivers, factory manager.

RANGER AIRCRAFT ENGINES plant at Farmingdale, Long Island, recently enlarged to provide more power for America's wings.

CLOSE TOLERANCES are in order on work that *has to be right*—like this cylinder barrel of a Ranger Aircraft Engine. The inspector is using a 24-inch Starrett Vernier Height Gage No. 454.

Planes and the engines that power them require extreme precision at every step of their production. That's why Starrett Tools are standard equipment throughout the aircraft industry. Write for complete Starrett Catalog No. 26V.

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All the dollars in all the pockets of America are a puny treasure compared with this. For the wealth we value most is the incalculably rich land we live on, and our freedom to utilize it for such benefits of peace as the epic dam at Boulder.

In a war-rocked world, America prepares to guard this land with hard thinking and straight action. Results alone count, and speed is all-essential.

No part of the armament we are forging is more vital than the defensive airplane. To the improvement and production of this weapon in its several forms, the Bell Aircraft Corporation has dedicated all its facilities.

A milestone of progress in the strengthening of our defensive forces is the new Bell Airacuda, one of the most potent weapons yet developed against aerial invasion. Designed for long range patrol and escort duty, this twin-engined multi-seater fighter plane is a product of collaboration with U. S. Army pilots and it is now in service with the U. S. Army Air Corps.

BELL

AIRCRAFT CORPORATION, BUFFALO, NEW YORK

Plane Financing in California

Because a citizen's ability to fly has become a potent factor of strength in national defense, Bank of America has inaugurated a plan to finance the individual purchase of airplanes on much the same basis as automobiles, according to announcement by L. M. Giannini, president of the bank.

Purchase of virtually all the smaller standard types of aircraft, Mr. Giannini says, now may be financed on the instalment plan through any of the 495 branches of Bank of America throughout California, and with insurance protection for both purchaser and the bank.

Planes produced today, the banker believes, are about as safe as automobiles. Rigid inspection by the Civil Aeronautics Authority insures the purchaser's getting a sound craft; and stern tests of piloting ability go as far as humanly possible to assure safe handling. He points out further that the cooperation of underwriters has made it possible to provide insurance somewhat similar to that for automobiles and other property. This insurance covers both flight and ground risks, thus affording substantial financial protection for the plane buyer and the bank as well.

Meteorology Training

The government will train 100 meteorologists this year at five colloges: M.I.T., Cal. Tech., Univ. of Cal. at Los Angeles, Univ. of Chicago, and New York Univ. The program is a joint enterprise of C.A.B. and the Weather Bureau. Applicants must have complete primary C.P.T.P. training, hold a bachelor's degree, agree to accept military or Weather Bureau service, and be physically qualified. Weather Bureau in Washington is doing the selecting.

Work has begun in Birmingham, Ala., on a new $171,000 hangar at Municipal Airport for use of the 106th Observation Squadron of the Alabama National Guard. It will have a 24-ft. entrance and facilities for taking care of ten modern warplanes, also dormitories, mess hall and work shop.

The airplane traffic control center established by CAB at Lunken Airport, Cincinnati, began operation Oct. 15, Col. Donald H. Connolly announced. It employs fourteen persons, including traffic directors, radio operators and other personnel and controls 1,090 miles of airways.

Flying altitudes are controlled between Cincinnati and Columbus, Cincinnati and Louisville, Cincinnati and Charles, W. Va.; and Cincinnati and Indianapolis. Other steps will be taken to prevent collision and traffic congestion.

This center is one of two new ones, the other being at Seattle, Wash. Both will coordinate traffic movements with the twelve control centers now functioning.

Ohio Airports

Ohio's airports will be rehabilitated with $18,000,000 in federal funds, of which $1,100,000 may be spent in Cincinnati. Plans are said to include $860,000 for either a new super airport in the city or improvement of Lunken Airport; $196,000 improvements at Mt. Healthy Airport and $28,000 at Western Hills Airport, both west of the city. If a new super-airport is built near Cincinnati, it is probable it will be built on an old race track north of Sharonville, Ohio, 13 miles from Fountain Square and 13 miles north of the new Wright engine plant.

Covington, Ky., across the Ohio River from Cincinnati, will get a Class 2 airport costing $180,000. It will have at least one lighted runway, that is hard surfaced and between 2,500 and 3,500 ft. in length. Planes carrying up to 20 passengers can then stop in Covington which is Kentucky's second largest city and only three minutes from Cincinnati by street car but now has no commercial landing facilities.

City officials in Cincinnati will fight any abandonment of Lunken Airport here on which the city has lavished $1,300,000. Its great advantage is its proximity to the business district. It's liability in the past has been that it was subject to floods every few years but this is being corrected.

Goodyear Tire & Rubber Co. has just bought this Waco Model E Aristocrat for use in all-round test and service work. Left, Larry O. Guinther, manager of Goodyear's Airplane Division, right, Clarence O. Bell, sales engineer and pilot of the ship.

THE FIRST AERONCA EVER BUILT. This ship turned out in 1929 and in continuous service since then, is now honored by being placed in the Aeronca museum in Middletown, Ohio. Engine is a 30 hp. Aeronca 107.

Correction

In the September, 1940 issue of AVIATION a report was published to the effect that Clover Field municipal airport of the city of Santa Monica was to be closed to the public and used exclusively for the Douglas Aircraft Co. in its expansion program.

An investigation has disclosed that, while such action was attempted by the city officials of Santa Monica, considerable opposition arose from among residents of Santa Monica resulting in the delay, if not abandonment, of this plan of procedure. In any event, private flying is still being maintained on this field and private operators are able to obtain service and attention in the usual manner while stopping at this port.

Clover Field is a municipally owned airport upon which more than $300,000 of WPA money has been spent in improving runways within the past five years, and from which a considerable volume of private and commercial flying has been done.

The original expansion plan as announced by Santa Monica officials involved extension of the existing field to the east, west, and south, scrapping much of the existing runway system, taking over a large portion of an adjacent municipal golf course, and spending an additional $600,000 of public moneys in further expansion and improvement of runways. Under the contemplated expansion the main runway would extend east-west a distance of 4,080 ft. and have a paved width of 400 ft., which extension is made necessary to accomodate larger aircraft to be tested in future by the Douglas Aircraft Co.

Groden L. Cahill who runs Cahill's Flying Service at Bridgeport, N. J., is now a publisher as well as an operator. The first issue of his "Cub Port News" was issued in July, by Don McAnally who serves as editor. The 4-page news is filled with personal items concerning Cahill's students.

The middlewest will gain another municipal airport if the Falls City, Nebraska, Junior Chamber of Commerce is successful in its campaign. Aided and abetted by oil men, the Chamber of Commerce points out that if Falls City expects to become the center of oil development for this area, an airport is essential.

Canadian Aviation News

By James Montagnes

A medical unit is being established for Canada's air force to be known as the Royal Canadian Air Force Medical Corps and will be entirely separate from the Army Medical Corps which has looked after air force medical problems to date. The new unit's formation was announced Sept. 19.

The formation of the air force medical unit comes after doctors trained in the special medical problems of flying at high speeds and high altitudes had tested 1,500 students for air crews in the R.C.A.F. with a brain testing device. In addition to the brain testing device, a pressure chamber testing system to check on high-flying effects on students has been used, and is being extended. If a student becomes ill at heights under 17,000 ft., as developed in the pressure chamber, he is considered of little value as a member of an aircrew and is then trained for a ground job, thus saving time and money on the training of air crew members.

At Toronto this winter between 600 and 1,000 Norwegians will be in training for new units of the Royal Norwegian Naval Air Force and Royal Norwegian Army Air Force. A training camp has been established, and Norwegians who escaped from Norway are being trained into the flying and servicing of Norse ordered American-built Lockheed Hudson bombers, Curtiss P-40 fighters, and Northrop seaplane patrol bombers. For preliminary training in Canadian planes de Havilland Tiger Moths and Fleet Finches are being used at Canadian fields, along with Fairchild basic trainers ordered by the Norwegians.

Need for more aircraft plant workers is seen in an appeal of the de Havilland Aircraft of Canada to the Toronto Board of Education, asking that 800 boys be trained in technical school aircraft courses during the present school term, the boys on graduating to be absorbed in the company's plant.

Leavens Bros. Air Service, Toronto, was given the mail contract for the winter from Leamington to Pelee Island in Lake Erie. Because of heavy storms in winter this 22 mile gap between Pelee Island and the mainland is served by air in winter with mail, freight and passenger accommodation. Other such winter services are in the St. Lawrence River and St. Lawrence Gulf areas.

RALPH P. BELL, president of Federal Aircraft Limited, who is the big boss of aircraft production in Canada.

Trainees for gunners, observers and pilots under the British Empire Air Training Scheme wear Royal Canadian Air Force uniforms but are distinguished from the rest of the R.C.A.F. by wearing white markers in the front of their caps. First graduate ground radio operators under the Empire plan had arrived in Great Britain in mid-September according to word from Ottawa. During September the first fully trained air observers under the plan were graduated. In September there were 4,500 air crew members in training, with 7,500 ground crew members in training, and an instructional and administrative staff of 9,000.

Delivery has been started on 119 North American Harvard trainers originally ordered from the United States by France, and which have been taken over by Canada. Instrument readings on these planes are in French, with English equivalent painted around the dials. The planes are being used at intermediate and advanced training schools by the R.C.A.F.

Under sponsorship of the Royal Canadian Air Force, a junior organization of air cadets among boys of 15 and 16 years of age is being set up across Canada. The corps is being organized to provide for the training of air cadets to fit in the British Empire Air Training plan, and boys undergoing training will be given preference when signing up with the R.C.A.F. on their 18th birthday. The air cadets will wear a uniform approximately like those of the R.C.A.F. The corps will finance itself without government aid.

TRAINING

Air Youth Scholarships

Air Youth of America, headed by Winthrop Rockefeller and Tom Beck, has announced scholarships valued at nearly $5,000. Winners will be sent to the Boeing School at Oakland, the Casey Jones School at Newark, or the Spartan School at Tulsa. Applicants must have graduated from a high school in the past three years, or those who will finish high school next June. Winners will be selected on the basis of school records and accomplishments in junior aviation. For details write to Air Youth, 30 Rockefeller Plaza, N. Y. City.

Air Classes Have Long Waiting List

PITTSBURGH—The air training class had to place on a temporary waiting list three times as many students as applied for a course in ground service and maintenance of airplanes at the new South Vocational High School, C. L. Stirling, Principal, reports.

A government-approved parachute station will be inaugurated by the Kansas City Flying Service September 15, in addition to their charter service and flight instruction, according to recent announcement by Edgar F. Smith, one of the owners. They will pack, service, repair and sell parachutes for this area.

FRED VILSMEIER, president of the Rising Sun School of Aeronautics, Philadelphia, which is the most recent mechanic's school to receive a contract for training Air Corps mechanics.

Training for Wright

The first contingent of 180 men and youth who were taken from WPA, NYA and unemployment rolls to learn and relearn industrial skills at the Mechanical Trade School, Cincinnati, completed their studies covering 300 hours in the study hall and machine shop conducted by the Cincinnati Board of Education. Of the 180, 35, or 18 percent were placed in jobs. Of the remaining 145, 133 passed their examinations.

Today 150 men and youth sent by WPA began their studies. The Mechanical Trade School is operating on several shifts a day to handle its regular day pupils, its evening school for those employed in industry and its retraining in skills for the unemployed.

John Arundel, director of vocational education, hopes to have a reservoir of trained labor on which the Wright Aeronautical Corp. and other local industries can draw. The Wright Co. is not expected to begin actual operations here for several months.

Cal-Aero Academy's new $600,000 training center at Ontario, Calif., was dedicated September 14 following a record-breaking 40-day construction program. Located on a 375-acre tract of land, it is equipped to handle 600 students at a time. Cal-Aero Academy is the new name of Major C. C. Moseley's Cal-Aero Training Corporation, contractor for primary training of Army Air Corps flying cadets at Glendale, Ontario and Oxnard, Calif. Major Moseley is also president of Curtiss-Wright Technical Institute, which is now training 1200 civilians and 1053 Army enlisted men in technical aviation work.

Ryan School of Aeronautics, San Diego, recently awarded a $1,110,566 contract by the War Department for training Army Air Corps pilots, started operations at its new Hemet branch school on September 16th with a class of 70 cadets, following completion of a $125,000 building program. Construction included nineteen duplex barracks units, ten administration and class buildings, and two 140 by 150 ft. hangars. The mess hall measures 170 by 42 ft. and seats 160 men, with a private dining room for officers, a large cadet lounge, and a complete canteen-restaurant. Total personnel stationed at the Hemet branch exceeds 225.

Eight new buildings erected at a cost of $100,000, are nearing completion at Curtiss-Wright Technical Institute, Glendale.

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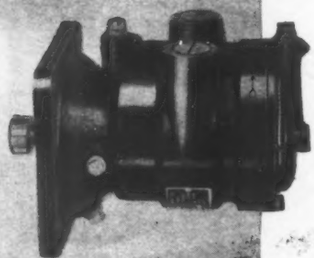

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Four-Way Valve

Hydraulic Pump

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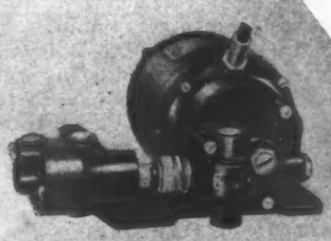

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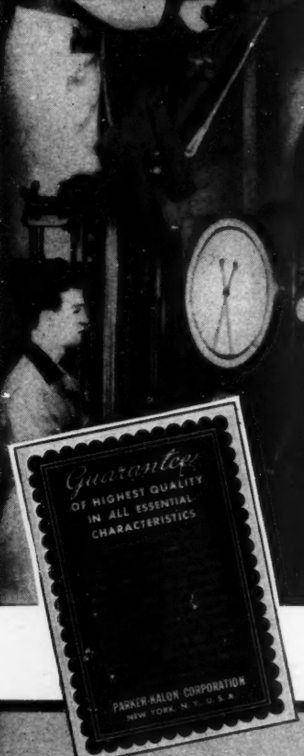

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To walk into the Parker-Kalon "Lab" is an amazing experience for any man. Nobody expects to find such complete and modern quality-control facilities in the screw industry. Often visitors who witness the routine which starts with analysis of raw material and ends with scientific tests of finished fastening devices, ask – *"Does all this have any practical value to the user?"*

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Window Shopping

Caterpillar Magazine—Issue 79—This attractive publication dealing with hauling and portable power problems is of wide interest to aircraft manufacturers and operators. Caterpillar Traction Co., Peoria, Illinois.

Lubrication of New Departure Ball Bearings—A 15 page booklet covering both selection and application of oils and greases. New Departure Division, General Motors Sales Corp., Bristol, Conn.

Coupling and Fitting Wall Chart—A metal bound heavy paper chart with varnish finish for durability when hung in the shop, this handy form lists and illustrates a wide variety of standard and triple tube couplings, combination and reducing fittings, Air Corps style. The Parker Appliance Company, 17325 Euclid Ave., Cleveland, Ohio.

Buffing and Polishing Machine—Bulletin No. 38-A—Standard Electric Tool Company, 1919 W. 8th St., Cincinnati, Ohio.

Metal Working and Finishing Performance Data—A new booklet dealing with metal cleaning and metal working lubricants, full of usable and practical ideas. Magnus Chemical Company, Garwood, N. J.

Blackhawk Torque Indicators—A folder listing the special line of Blackhawk torque indicating wrenches. Catalog No. 40-T. Blackhawk Manufacturing Company, Milwaukee, Wis.

Hoyt Electrical Instruments—An 8-page catalog of ammeters, voltmeters, milliammeters, switchboard instruments and portable instruments for all purposes. Burton-Rogers Co., 857 Boylston Street, Boston, Mass.

Rex-Weld and Rex-Tube Flexible Metal Hose—**Catalog G-21**—A 38-page catalog of the complete line of metal hose offered by this firm. Chicago Metal Hose Corp., Maywood, Ill.

Cincinnati Shapers—**General Catalog N-1**—A 28-page presentation in attractive and detailed form of the complete line of Cincinnati shapers. The Cincinnati Shaper Co., Cincinnati, Ohio.

Bakeflex—A folder describing a new floor finish for application to hardwood, linoleum, asphalt tile, rubber tile, concrete, terrazzo, and, in fact, every type of floor. Flexrock Co., 2300 Manning St., Philadelphia, Pa.

Flexrock—A folder describing a flexible concrete for refinishing old wood floors.

Colorflex—Folder describes a resin base floor dye, not a paint, which preserves wood floors, protects concrete. Flexrock Co., 2300 Manning Street, Philadelphia, Penna.

Safety Equipment Price List No. 4 for Safety Catalog No. 40—Covers face shields, goggles, gloves, and all forms of safety equipment. The Boyer-Campbell Co., 6540 Antoine, Detroit, Mich.

ExCello Precision Thread Grinding—A 12-page folder on the process of precision thread grinding. Ex-Cell-O Corp., Detroit, Mich.

Gisholt Performance Data Sheets Nos. 46–47–48–49—Describe special turret lathe problems solved with Gisholt equipment. Gisholt Machine Co., Madison, Wis.

Hanover Uniform Catalog—For the aircraft shop or plant wishing to fit all employees with a standard uniform this catalog will provide desired information on low cost quality merchandise. Hanover Uniform Co., Baltimore, Maryland.

Resistors and Rheostats—**Catalog No. 40**—A catalog of interest to the plant electrical engineer. Hardwick-Hindle, Inc., Newark, N. J.

Howard Aircrafter for 1940—Describes the 1940 Howard line of aircraft. Howard Aircraft Corp., Chicago, Ill.

Safety Clothing for Industry—An 18-page catalog devoted exclusively to safety clothing such as gloves, mittens, aprons, leggings, etc. Industrial Gloves Co., 700 Garfield Blvd., Danville, Ill.

If You Were to Build Your Own Ship—A booklet issued by Lockheed Aircraft Corp. containing the answers to a questionnaire sent to 1,000 pilots, maintenance men, and others, asking for opinions on specific features of airline plane design. Lockheed Aircraft Corp., Burbank, Cal.

New Type Speed Lathe—**Bulletin 152**—Describes a production machine for light polishing, countersinking, burring and reaming work. Standard Electrical Tool Co., 1919 W. Eighth Street, Cincinnati, Ohio.

Steelweld Bending Presses—**Catalog No. 2002-7**—A handsome and liberally illustrated catalog covering the "Steelweld" line of bending presses, with related data. The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

Republic Double Strength Steel—A two-color 40-page catalog on Republic double-strength steel, a high tensile low alloy product. Advertising Division, Republic Steel Corp., Republic Building, Cleveland, Ohio.

"Quick Selector" Catalog No. 30-000—A 64-page book designed as an aid to selection of correct apparatus for any electric motor, lighting, or feeder circuit.

Fractional Horsepower Motors—**Bulletin F-8548**—A 4-page bulletin dealing with a.c. and d.c. motors of 1/20 to 3/4 hp. Westinghouse Electric & Manufacturing Co., East Pittsburgh.

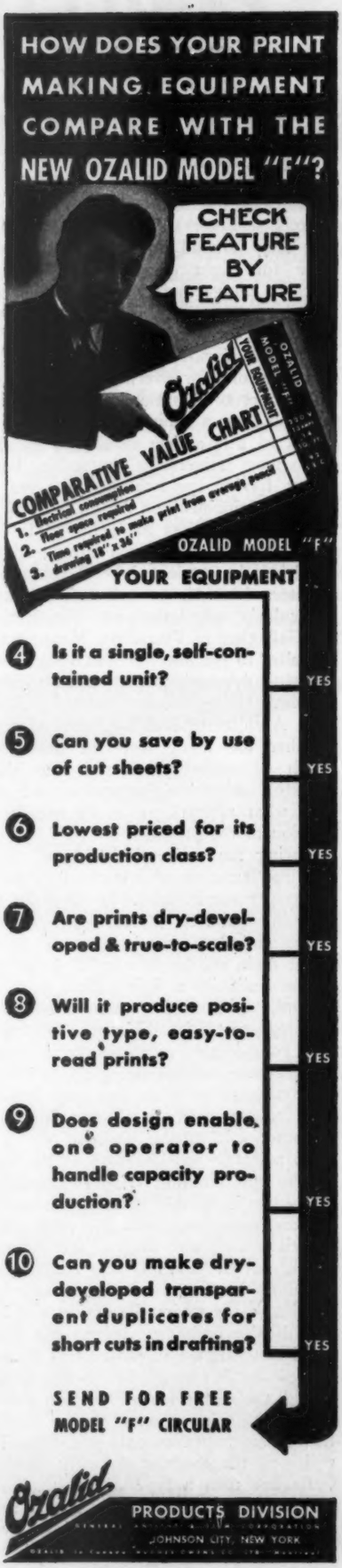
Recent Books

LANDFALL, *by Nevil Shute;* William Morrow & Co., New York; 284 pp., $2.50

Any closeup of Britain's R.A.F. is absorbing reading these days. As in "Ordeal" and "An Old Captivity," Mr. Shute's painstaking aeronautical details create a realistic story that is especially interesting for aviation readers. Although the incident about which the plot treats infers that Britain's Navy slipped up on what was pretty obvious to the heroine (and the reader), "Landfall" is a good yarn, and one's admiration for the spirit and the job of the R.A.F. pilot is borne out by the story that history is writing at this very moment.

HOW TO GET INTO AVIATION, *by John B. Walker.* Random House, New York, N. Y. 126 pages, $1.00.

Here is a book by one who knows, dealing with a subject that is timely to the defense of our country as much as to the young individual just starting to carve a career for himself. There was never a time when it was more important to our future, and especially to the future of aviation, that we fit square pegs into square holes, and round pegs into round holes. This book is designed for exactly this purpose. It covers the field authoritatively for both men and women, treating the full range of possible positions; clerks, mechanics, pilots, salesmen, radio operators, stenographers, stewards, photographers, timekeepers, passenger agents, draftsmen, accountants, engineers, etc. It defines the needs and opportunities in civil and military aviation, and contains an entire chapter on "Learning to fly at government expense." Names and locations of all the leading aircraft firms are given, the nature of the jobs now open, or that will be open, the salaries paid, and in many cases the names of the persons who do the hiring.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Airport Clubs

(*Continued from page 39*)

such purposes cannot be given in this treatise.

Basically the needs for a structure entirely separate from hangar and repair shop should include: operations office for flight checking and traffic control; lounge and living room space for pilots, owners and guests; minimum provisions for serving food and beverages; toilet facilities and minimum accommodations for overnight transients. The proper combination of these facilities has been a difficult matter. Suggested in this article is a plan which seems most universally acceptable. The writer, having spent the last five years almost continuously on the go from airport to airport, has made hundreds of mental notes on how such an operation could best be conducted. Not being an architect himself, a well-trained and particularly suited designer, Mr. Richard Gallagher of Brookline, Mass., was consulted to put into line and design the thoughts developing from these observations. Gallagher, a graduate of the Yale Architectural School, has pieced together the many different thoughts which of necessity entered into the needs of such a building and wound up with what appears to be an excellent solution to the problem.

During the entire designing of this building, expense of construction was kept uppermost in mind. It was thought that the building should not exceed $5,000, and thus what is presented here as the main exhibit is a building which can be built for a figure close to that amount. It must be remembered that building costs in different localities vary considerably, with the result that definite cost analysis is impossible. For more complete coverage two other buildings are shown, one less expensive, and the other with all the "fixings."

Of primary consideration in the design of this building was the necessity of having it flexible to meet increased business conditions with the expansion of aviation. Three designs are shown, A, B, and C. Plan B was considered the most ideal and of most universal use, hence the major discussion will be on this size building. It was felt that wood construction in most parts of the United States would be cheapest, although the design lends itself admirably to stucco finish and other similar types. Its outside appearance is suggested in white as the exterior drawing shows. Gallagher uses a type of construction which avoids awkward shapes and unnecessary projections, thus cutting down expense. The whole thing has been arranged so that digging of foundations is unnecessary. Since this is usually a major expense in construction, considerable saving is effected. The heater room (7) is centrally located in a room on the ground floor, hence not even the furnace need be sunk. A modern, compact oil burner is recommended.

The general design of the building has taken into consideration maximum efficiency for airport operation as well as maximum visibility of lounge occupants. The operations office projects out in front of the building with full windows on three sides, commanding practically the entire airport. For less complicated operations, a traffic-control light gun can be operated from this room which also has space for two desks, a counter facing the vestibule and radio receiving and transmitting equipment. While not shown, a regular control tower can be added on top of the operations office. The railed roof above the office can serve admirably for a tower operator on busy days. At the same time this can be used as an observation deck while the whole roof can be so converted if desired.

To a certain degree, privacy of the lounge has been effected in case it is to be used exclusively for students or club members. Entrance from driveway is made through door (1). Visitors are immediately faced by the operations counter or information desk at (3). Through door (2) they may go directly to the terrace facing the airport without going through the lounge at all. Toilet facilities are also located in such a way that the general public may use them without molesting the privacy of the lounge. A desirable feature has also been incorporated in the restrooms; namely two-deck bunks which are mighty handy for hasty cross-country pilots who want to leave at the crack of dawn. Locker space is provided and shower facilities.

The lounge is large and roomy with generous window space for observation of flight activity. The angles of vision have been so arranged that a minimum of obstruction is noticeable. The fireplace, for instance, has been located on the driveway side of the room. For the balmier seasons the lounge opens out on a canopied terrace where garden furniture could accommodate a considerable number of visitors. Off the lounge and near the operations office is a small kitchenette and lunch counter (5), which may or may not be available for service at all times. It is satisfactorily designed for service of hot and cold sandwiches, beverages, and light lunch. It could easily be run by the office girl and on busy days by a full-time person. Any one who has done considerable cross-country flying knows how pleasant a snack and a cup of coffee can be after a long trip. It would serve well for increasingly popular breakfast flights and during dance nights a regular bar could set set up for service.

The checkered area surrounding the building can be of tile, flag stone, or gravel. The area (12) east of the building should by all means be tile or some similar inexpensive paving.

Plan A is a smaller version of B, while plan C is merely an outgrowth of it. The lounge, office, kitchen, toilet, and heater room in A are identical with those in B. In other words, if initial expense is to be kept to a minimum, building A can be built first and later additions can be made to bring it up to the size of B. Building C likewise is an outgrowth of B with two private double bedrooms added on the right and more complete kitchen, bar and service facilities on the left. The double bedrooms are readily convertable into an apartment for the manager's use. While at first glance the design of Club C may seem too elongated, this was done for several reasons. Primarily it allows simple addition of structure and also keeps the building from occupying more room on the flight area. A false ceiling is incorporated in the construction designs so that necessary wiring and piping to accommodate the additions can be done at a minimum of cost.

The function of the building is manyfold. Primarily it offers the operator an excellent office and operations center. It provides students and plane owners a place to visit or to bring their friends; it serves, to be exact, the same purpose as a country club or a yacht club. It maintains and develops interest in flying through the facility of holding dances, parties and club meetings.

How to finance is a problem which may be solved in a number of ways. The average operator feels that what capital he has should be invested in hangars or new equipment. More and more we are seeing, however, that much more than merely hangars and airplanes are necessary for the conduct of a smart flying service. Possibly the happiest solution would be the formation of a local aviation club which would undertake the financing of it through membership fees, leasing office space to the operator, and giving out a food and beverage concession.

There is little doubt that the construction of this type of building on an airport would do much to stimulate greater interest in flying, retain interest already started and make the airport a much more attractive place to visit. Inquiries, either to the author or the designer, Mr. Gallagher, are welcomed through AVIATION'S New York office. More complete details and information are available for those interested.

Southward with CYCLONES *in* THE GREAT SILVER FLEET

EASTERN AIR LINES LAUNCHES NEW CYCLONE-POWERED DOUGLAS FLEET

THE GREAT SILVER FLEET links major Eastern and Mid-Western industrial centers with the increasingly important routes to Central and South America. This, together with new Mid-Western route extensions, is reflected in a 56% traffic rise in September over last year—an all-time monthly record. The annual Winter travel to the South will add its impetus to the greatest growth in EAL's history.

Current delivery of additional Douglas DC-3's and DST's, powered with Wright G-200 Cyclones, will double Eastern Air Lines' present fleet. Since the start of operations twelve years ago, Eastern has consistently specified Wright Aircraft Engines for its new equipment.

WRIGHT AERONAUTICAL CORPORATION
Paterson **New Jersey**
A Division of Curtiss-Wright Corporation

WRIGHT *Aircraft* ENGINES

Bombers In Quantity

(*Continued from page 37*)

ous subplanning departments in each of the manufacturing sections while all of the flow is controlled by the main department. When the preliminary work previously described has been carried out notice is given to them and they begin to issue orders to start production. While all of the preliminary work in the other departments was being carried out they were doing all of the necessary paper work in the line of requisitions, progress cards, etc. so that everything was waiting for the go-ahead signal. Each part to be fabricated has been entered upon a routing card and an operation card.

Through a time-study system the central planning department has been able to assign to a given machine any operation that is required to fabricate a certain part. Instead of the operator going to the various stockrooms to secure his tools and materials, they are delivered directly to the machine. This requires an intricate transportation system, all of which comes under the control of the central planning department. At regular intervals trucks which are part of this transportation system pass by the machine and pick up the finished parts and deliver them to the inspection department. After they have been inspected they are delivered to a finished-parts stockroom and there await requisition for the next assembly. Shortly before an operator of a machine has run out of material he indicates this by raising a flag on the machine. A man in the departmental planning department when seeing this flag routes more material over to that machine. Each machine is numbered and the number with the name of the machine is located in the central and departmental planning departments.

General Plant Layout

The Martin plant is divided into three buildings, which we will designate as A, B and C buildings. They are located side by side with adjoining walls and doorways, through which material can flow from one building to the other. In front of A building is located the executive offices and in front of B building the engineering and research departments. Behind the factory buildings is located a large cement apron on which the completed airplanes are rolled when coming off the production line. "A" building was the original Martin plant, built at the Middle River site in 1929 on 1,243 acres of land. The present floor area is 1,263,000 sq.ft., all of which has been financed with the company's own funds. Recently ground was broken to add an additional 400,000 sq.ft. into which will be installed nearly $1,000,000 worth of new machinery and equipment.

Production Line

So far only the small parts have been discussed. The larger subassemblies, where sections are fabricated from these parts, are distributed in the three main factory buildings, close to the assembly lines. The efficient methods and machines used in fabricating the Martin airplane are known throughout the industry. Martin's production men have been among the leaders in designing metal jigs with which to make the airplane in the minimum of time.

One of these machines is the rotatable circular jig for making the bulkhead and former ring of fuselage. Revolving about its center this jig has on a circular plate held vertically the template of the bulkhead to be formed. This template had come from the photographic department printed with the engineering drawing to be used in the design. The various parts of the jigs are then built up upon this template and into these the preformed sections of the bulkhead are fitted. The workman in assembling the bulkhead can rotate the jig to the most convenient position for him and by this drill and rivet in the most efficient manner. When these bulkheads are completed they are sent to the large steel jigs which are built for use in the fabrication of the remainder of the fuselage.

Accessibility to the various parts of the airplane during construction has been an important factor long realized by Martin production engineers. One of the limiting factors as to the maximum production speed obtainable in a given plant, is the number of workmen that it is possible to have working on a given piece at one time. In order to tackle the problem, jigs were designed which divided the airplane into as large segments as possible and still gave ample room for the workmen. A large fuselage and wing jig were the result and in addition another feature was added which has been proven to be one of the important items leading to Martin's enviable production.

The nose and tail sections of the fuselage heretofore have been one of the most difficult parts to build inasmuch as it was necessary for a workman to crawl down inside the fuselage during construction to assemble the parts. The Martin engineers decided to split the nose in two parts, thereby eliminating the necessity for a workman to be confined in a small space inside the ship. This resulted in a great deal more elbow room for the workmen and at the same time it allowed all of the units on each half of the ship to be assembled independently, and then joined together just before the final step in the production line.

A typical production line begins at one end of the plant and flows down through the center and out the other end. The small and subassembly parts that were described previously are made in other sections of the plant, a great many coming from the drop hammer building and others from building A and from the basement of building C. At the beginning of the production line are the steel jigs used in the construction of the outer wing span. Next to this, on one side of the plant, is located the center wing section department and on the other side the large steel jigs in which the fuselage begins to take its shape. In the center of the plant are located the nose section department and the line down which the ship moves as assembly gets under way. As the wing center section travels down this line, it is joined from one side of the plant by the rear fuselage section and from the other side of the plant by the nose section, each part having been almost entirely completed in its own department in the special steel jigs just described. As the work progresses to the end of the line it is joined by the tail section, and picks up engines and landing gear on final assembly at the far end of the building. Here in a large open space the various parts of the ship are spliced together and passed out of the building upon completion to the large cement apron behind building B. After the necessary tests have been given to the completed planes they are taken off this apron in either one of two directions. If to be flown away they are taxied to the adjoining Martin airport, which is one of the largest private airports of its type in the world. If the ship is to be sent by rail it is taken off the cement apron into the rear of building A where there is a large section called the tear-down department. In here the ship is dismantled and crated and carried out on to the loading platform located beside building A.

In B building most of the flying boats for the Navy have been constructed. As they pass down their production and assembly lines they are also wheeled out through large doors on to the cement ramp. When these ships are ready for delivery they are rolled down a concrete ramp on special dollies out into the bay and flown to their destination.

(More material on Martin Production to follow in an early issue).

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Aviation's Broadening Markets

(*Continued from page 47*)

sales would be facilitated, increased profits should be realized in view of the higher profit margins prevailing on foreign deliveries.

The "freezing" of airplane designs would also represent a revolutionary development for the aircraft industry and permit more readily the mass production of planes.

It is reported that on a recent order for 500 planes, so many changes were made that the last unit was very much unlike the first. Under such circumstances, the aircraft builder, instead of placing the entire order on a production line schedule, was manufacturing a series of custom-made airplanes.

It is only with a volume of orders and standardization of designs that the aircraft industry can adopt mass production techniques. It has not had the opportunity until now.

Little credence should be given to the view that design "freezing" will stop aviation engineering progress. A prime example in this respect is the automotive industry. Every year, well in advance of automobile show time, car designs are "frozen" for production. Yet the automotive industry, based on extensive research programs, has advanced important engineering developments and improvements from year to year.

Research and development projects are constantly in progress by the aviation industry. In fact, such research programs may be considerably enlarged in view of the excess profits tax measure recently enacted. Aircraft manufacturers may find it more advantageous to increase appropriations toward research projects as such deductible expenditures serve to reduce tax bills and permit the indirect plowing back of profits.

The much-discussed and long-delayed Excess Profits Tax of 1940 is finally on the statute books. At first glance, it would appear that aircraft manufacturers are hard hit by this measure. As this confused bit of tax legislation, however, contains so many qualifications, and permits the Treasury Department to adjudicate "abnormalities," it should not be difficult for the aircraft industry to avoid the harshness of the tax law. Further, as many of the aircraft builders entered into special agreements with the Treasury Department when expansion programs were embarked upon, it should be a simple matter for these companies to find "abnormalities."

Moreover, while creating many a headache to statisticians and tax experts, the recently enacted tax law may be of academic interest only. Informed sources believe that this tax measure is only a temporary one and undoubtedly will be repealed and completely rewritten at the next session of Congress.

It is likely, however, that certain tangible benefits of the present law will remain. The repeal of the Vinson-Trammell profit limitations, previously imposed on the aircraft and naval construction industries, is bound to have a salutary effect. No longer will the aircraft builders (and shipbuilders) be subjected to discriminatory profit limitations on domestic military business.

The five-year amortization provision, contained in the tax law and dealing with new defense plants erected since June 10, is also bound to have a constructive influence on the aircraft industry. This provision covers those contractors who agree to purchase, erect, or install specified new plant and equipment required for production of government orders. The government, in five equal annual payments, agrees to reimburse the contractor for all of his expenditures. The price of supplies produced in such plants is to be negotiated so as to remove the element of plant depreciation from the cost of supplies.

These arrangements permit the contractor to take such a contract to his banker and assign it as security for a loan to cover the cost of the facilities. Payment of the cost is guaranteed by the government, without regard to the general credit of the contractor, and regardless of the success or failure of the supplies contract.

The Federal Reserve Board has polled the bankers as to the amount of money available for defense loans. About $3,000,000,000 has been indicated as available for such "bankable contracts," an amount declared by Mr. Knudsen to be more than ample for all needs. As the bankable contract has the attributes of a government obligation, such loans should, and probably will, carry a lower than ordinary interest rate.

Such interest rate, however, will not be as low as the yield from government obligations of comparable maturity. The most important reason is that nonperformance or unsatisfactory performance of the contract could jeopardize the receipt of payments from the government when due, thus introducing an element of credit risk which does not exist when a bank purchases direct obligations of the government.

The air transport companies are definitely favored under the present tax law. The Excess Profits Tax of 1940, while ambiguous, is interpreted to mean that the air lines shall be subject to this special tax only if their net profit exceeds their mail revenue. Along with other corporations, however, the air carriers will be affected by the increase of the normal tax rates from 20.9 percent to 24 percent.

In no case is it expected that mail revenues will even equal the net income for any of the leading airlines for this year. Table I shows projected 1940 mail revenues as compared to estimated 1940 net income for the individual companies. Incidentally, this preliminary estimate also presents our ideas as to how the leading transport companies will finish the current calendar year. It must be recognized, however, that such estimates are merely tentative and do not anticipate any special year-end adjustments.

Mail revenues will continue as a potent factor in determining the future earnings trend of the air transport industry. It can readily be seen, by examining Table I, that mail compensation is absolutely essential to permit the air carriers to even approach profitable levels. It is significant, however, that the relative importance of mail revenues is declining with the corresponding increase in passenger income. For example, for the fiscal year ended June 30, 1940, the industry derived 68 percent of its revenue from passengers, with only 28.4 percent coming from mail. For the previous year the percentage ratio was 60 percent and 35 percent, respectively.

A number of recent developments indicate that important changes may occur in the rate of mail compensation to be paid certain individual air carriers and the industry as a whole.

The CAB has, upon petition, reopened the proceedings dealing with the recent rate decision of United Air Lines and upon its own motion is instituting an examination of the rate structure of Pennsylvania-Central Airlines. Moreover, the board has called an informal conference of all air line companies for Dec. 2 to consider proposals for revising the formula for fixing rates of pay for carrying air mail. It has been indicated that a new formula will not be adopted until the air carriers have had the opportunity to present suggestions.

The economic regulation of the industry may well be determined by any final formula of rate making arising from such conference.

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Factory Training

(*Continued from page 33*)

though the bulk of this money will probably be spent for training of aircraft workers. Present instruction is divided about evenly between instruction of unemployed candidates for aircraft jobs, and those who are already at work in the aircraft factories. Instruction is given in aeronautical engineering, production engineering, tool planning, tool designing, aircraft lofting, toolmaking, die making, machine operation, welding, pattern making, template making, tool and jig building, aircraft service mechanics, and all-around mechanics. Limited teacher training courses are also given in order to provide needed teachers and to standardize instruction.

In Los Angeles proper there are now more than 1,500 students under instruction in connection with this program. In Burbank, largely due to the activity of Lockheed Aircraft Corp., there are more than 4,000 active students, with the expectation that a peak of more than 10,000 will be reached early next year. In San Diego, a special effort has been made to meet the needs of Consolidated Aircraft Corp. The city of San Diego is building a $367,000 school plant for the San Diego Vocational School, which is operating under the National Defense plan. Larry Boeing, former Consolidated man, has been granted a leave of absence to act as head of the aeronautics department of this school. Sixteen hundred graduates of this school have been placed in San Diego industry during the first nine months of 1940, about 1,500 of them being employed by Consolidated. J. H. Waterbury, personnel director for Consolidated Aircraft Corp., has cooperated fully by providing 24 experienced men as instructors in sheet metal layout, riveting, welding, etc. Blueprint reading, shop mathematics, machine shop, and general aircraft construction and assembly, are also taught. Enrollment in this school exceeds 1,000 and about 260 men are graduated each week, major emphasis being on the short job training courses.

A review of private school activities does not permit mentioning even all of the outstanding private schools, due to the large number operating in this area. However, the better private schools all have in common the fact that they are working very closely with the aircraft personnel managers to provide men thoroughly trained to move into positions of responsibility in production. Graduates of such schools are generally capable of devoting all their time and attention to the problems of the aircraft plant which employs them, without having to devote long hours to further outside studies in school extension courses.

The private schools generally have an advantage over the public schools in being located on an airport or adjacent to an aircraft plant. Also, they teach only aeronautical subjects and the student can obtain as much information pertaining to his prospective job in a period of ten months as he could get in two years of public school.

We have mentioned the Curtiss-Wright Technical Institute of Aeronautics, located on Grand Central Air Terminal, Glendale. With an enrollment now around the 2,000 mark, this is probably the largest private aviation school in America.

Also in Glendale is the Aeronautical Institute of Technology, which specializes in aircraft production engineering and production methods. This school has close connections with a number of large manufacturers and has grown rapidly, now having an enrollment in the neighborhood of 1,000 students.

California Flyers, Inc., located on Los Angeles Municipal Airport, is an example of a fine type of private school, located almost in the backyard of the major aircraft plants. North American Aviation and the El Segundo Division of Douglas Aircraft Co. are both on this field, giving students an unusual opportunity of observing manufacturing operations as well as test flying. This institution conducts flight instruction, but the major emphasis is on aircraft manufacturing courses, with about 200 students under instruction.

American School of Aircraft Instruments, devoted entirely to instruction of instrument men, is an example of the specialization of some of the private schools. Located in Glendale, this school has grown rapidly in line with the need for instrument specialists. Another special school, recently opened in Hollywood, is the Academy of Aerial Photography, for instruction in all branches of aerial photography. One might think this out of line with the aircraft production problem, but investigation shows that a tremendous volume of aerial photography is done by all major aircraft plants.

The Boeing School of Aeronautics, Oakland, a division of United Air Lines, also has a direct relationship with Boeing Aircraft Co., Seattle, and has supplied many production men for Boeing and other factories. The Boeing School specializes in long term training of the most thorough kind.

The Ryan School of Aeronautics, San Diego, is unique in that it is a subsidiary of the Ryan Aeronautical Co. Thus the graduates of the Ryan School have, for the most part, gone directly into production work for the Ryan factory. The relationship also makes it possible to give students actual factory experience during the advanced stages of their school work.

There are several notable examples of short-term, job training schools which have been unusually successful. These include the Warren School of Aeronautics, Los Angeles, which has specialized in low-cost practical training, turning out graduates who have won wide favor with aircraft personnel men. Then the Fletcher Aircraft Schools of Santa Monica, Burbank, and South Gate, have worked with Douglas and Lockheed to give large volume short-term courses to prospective employees. Lockheed alone has put about 1,500 men through the Fletcher Schools and through the Powers Aircraft School, Van Nuys.

Summarizing the special activities of the various aircraft plants in this area, space permits only a sketchy outline. The Boeing Aircraft Co., Seattle, has faced a special problem due to its location far from a major source of skilled labor, and far from a major aircraft school. Boeing has received close cooperation from various California aircraft manufacturers in supplying key men. Local Seattle schools have supplied large numbers of job trained men. On-the-job training has closed the gap between the skilled and unskilled, experienced and inexperienced men.

Consolidated Aircraft Corp., San Diego, is close enough to the Los Angeles area to draw easily on the available trained aircraft workers from that area. The bulk of new employees, however, have come from San Diego by way of the San Diego Vocational School or the Ryan School of Aeronautics.

The Douglas Aircraft Co., Santa Monica, has faced a tremendous problem in upping the payroll from 7,000 to 18,000 people in one year. W. G. Jerrems, personnel director, and C. T. Reid, director of education, have combined all available facilities in staging a mass education program probably not matched by any other aircraft manufacturer in this country. As a result a total of 35 courses have been taught by Douglas personnel in public schools, private schools, or in the plant itself. These courses include: aviation for stenographers, blueprint reading, aircraft template development, aircraft assembly, drafting, aircraft tool design, aircraft hydraulic design, aircraft mechanical drawing, metal fitting fabrication, wood pattern making, aircraft plumbing, riveting, sheet metal layout, sheet metal work, shop mathematics, stress analysis, technical sketching, lofting, and welding. These courses and their various subdivisions are offered at: Santa Monica Adult Education Center, Curtiss-Wright Technical Institute, Douglas Aircraft Co., Frank Wiggins Trade School, Inglewood High School, John Adams Junior High

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School, Santa Monica, Santa Monica Technical School, United Aircraft School, Venice High School, Westwood Correspondence School, and the Willis Business College.

This brief outline will serve to illustrate the steps taken by one major manufacturer to meet the personnel training problem. Approximately 2,000 Douglas employees are currently enrolled in these courses, in addition to prospective employees undergoing instruction.

An interesting and significant problem is that faced by Interstate Aircraft & Engineering Corp., a subcontractor machining aircraft parts. About 300 machinists are employed at this plant, with the number being steadily expanded. It is no longer possible to hire experienced machinists in any quantity, and training machinists is a long and tedious process which has been begun too late in this country to satisfy the immediate need. Lawrence Ley, shop superintendent at Interstate, has solved this problem through combining a high degree of supervision with a system of progressive advancement for new men, or boys. The really experienced and capable all-around machinists available have been about evenly divided between the tool room and the shop. Those in the shop are used almost exclusively as lead men, to supervise work set-ups and to instruct green men in specific operations. Under such instruction it is possible to reach a high rate of production with comparatively inexperienced help. Boys out of high school but with thorough high school machine shop instruction, are hired and put to work on the burring bench. After several months of burring work, and as they show aptitude and opportunities open up, these boys are advanced to thread mills, where they are under close supervision. After a few months of thread mill work they go on to production mill work where, with careful supervision, they soon develop into good production men. This does not produce the all-around machinists such as are trained by the apprentice plan, but it does provide production machinists in the shortest possible space of time, and with maximum production efficiency while advancing.

A similar problem has been met by the Kinner and Menasco aircraft engine companies of Glendale and Burbank, respectively. Both have relied on accelerated training of younger men, under close shop supervision, to fill out the ranks of machine shop personnel. Also, a higher degree of machine specialization is necessary under this plan, restricting workers to the operation of equipment on which they have had experience.

Under R. Randall Irwin, industrial relations manager, the Lockheed Aircraft Corp. has conducted a long-range employee selection and training program. The Lockheed program starts with unusual care in selection of employees off the hiring line. It includes every conceivable avenue of employee training, including paying tuition of untrained employees through short courses in private schools, as previously mentioned, and also including unusually close cooperation with the public school system. Lockheed has also, largely at its own expense, initiated engineering brush-up courses for making aircraft engineers out of engineers trained and experienced in other fields, such as civil or structural engineering. Such courses are being given with the cooperation of the California Institute of Technology.

North American Aviation, Inc., has increased the payroll from 3,700 to 6,600 in a year and is now shooting for a total of 10,000 employees at the El Segundo plant (12,000 will be employed in the new Dallas factory). Under the direction of Major Howe Thayer, education director, North American has cooperated with many of the public and private schools already mentioned to provide adequate employee training.

Northrop Aircraft, Inc., has already advanced from zero to more than 1,200 employees this year, and expects to have 3,000 at work in the near future. A nucleus of this new staff were seasoned men from neighboring aircraft plants. The balance consists of new men obtained through the various established schools.

One thing worth mentioning in connection with the method used by Ryan Aeronautical Co. in obtaining students from the Ryan School of Aeronautics, is that the school has inaugurated a three-shift, 24-hr. per day training program in order to meet the factory's requirements for trained men.

Solar Aircraft Co., San Diego, employs a high percentage of welders in manufacturing the special Solar manifolds which are standard throughout the industry. These welders have been obtained from various schools and then carefully checked through a system set up in the Solar plant, which includes qualifying each welder to meet Army-Navy requirements.

Vega Aircraft Co., Burbank, as a subsidiary of Lockheed, has relied directly on the Lockheed organization to provide necessary executive supervision for expansion of the payroll, which has leaped from less than 100 to approximately 3,000.

Vultee Aircraft, Inc., Downey, has also undergone a high ratio of expansion, having increased payrolls from about 850 in 1939 to more than 5,200. This has been accomplished under the supervision of Gerald Tuttle, personnel manager, and George Ford, director of education and training. Mr. Ford has worked closely with various public schools in setting up courses and providing instructors. At Nashville, where Vultee recently took over the new Stinson factory, he found that the city had a charter provision preventing training anyone more than 21 years of age in the public school system. It was possible to modify this provision in line with the opportunity afforded Nashville residents of immediate employment upon completion of suitable aircraft training work. Vultee now has more than 50 employees who are doing part-time teaching in public or private aircraft training schools. Ford finds the greatest shortage right now in the field of experienced machinists, tool, jig, and die makers. He prefers a minimum short course of eight weeks and then wants the trainee to concentrate on learning to do one thing well, such as riveting, sheet metal layout, hand forming, assembly, etc. rather than trying to compress a whole education into such a short period. As with other personnel men, Ford would prefer the man with all-around training of ten months or more, if he could get him. Having to take the short-term trainee, he then encourages him to take extension courses at least one or two nights a week. All new men are put through a course of work training to advance them as rapidly as possible and make more room at the bottom for new men. Machinist candidates are started on bench work and later worked out into the shop under the close supervision of set-up men. Sheet metal workers are started on the simplest possible operations and advanced as they learn; riveters are started as buckers and on the simplest type of riveting, a green man always being placed with an experienced man. Promising lead men are selected for foreman training on company time, such training being given by Ford. Vultee expects to have 10,000 men at work in the Downey plant in the near future, and 6,000 at work in Nashville.

One lesson emphasized by many personnel men is that sheer manpower is not the answer to accelerating production. It is better sometimes not to expand too fast, or at least not faster than it is possible to train the key men who must supervise the green men coming in under them. Once those key men have been properly prepared for their added responsibilities it is possible to pyramid personnel with much greater rapidity. That is why Southern California personnel managers feel that they are "over the hump" and able to handle any future expansion program without drawing a deep breath.

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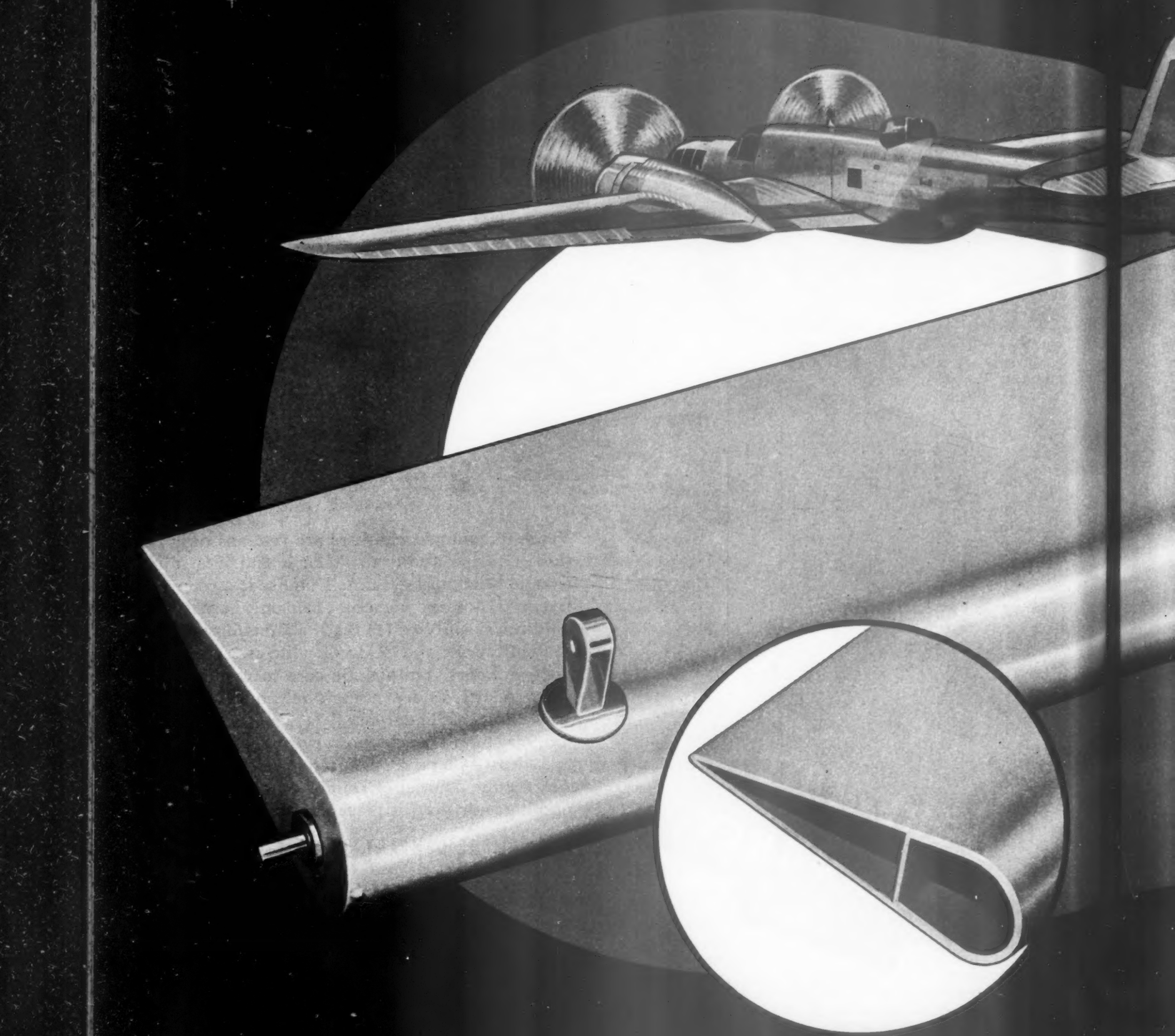

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Airline Navigation Was Different In Europe

(*Continued from page 41*)

points a regular radio schedule was maintained with both Amsterdam and Batavia.

There are no radio range beacons in Europe such as we have here, all radio navigation between terminals being done with direction finders. There is a DF station located at each airport which takes bearings on the planes. A pilot may have from these stations a true or magnetic bearing from the station to his plane, or a magnetic course to the station. He may also have his exact position at the time the bearing was taken. This is done by two or more ground stations taking bearings at the same time on the plane and relaying them to the station the pilot is working, where they are laid out on a map. The pilot is then given his exact position with relation to some point. Under normal conditions it takes two to three minutes to get a position report and except under rare conditions the pilot never asks for one. He keeps on his course by getting bearings from stations in line with his flight, with an occasional cross bearing to check his speed.

As a rule a pilot never asks a ground station for a bearing except when landing by QDMs, which will be covered later. Instead he uses his own DF and since he can take bearings on all radio stations it gives him quite a wide choice. Also, there have been installed radio navigation beacons for the use of aircraft. These work in sets of threes which are on the same frequency. Beacon number one at the start of a minute gives its call signal for 10 seconds then a long dash for 50 seconds, then beacon number two and three the same. Such a set of beacons is located at Paris, London and Amsterdam. By taking bearings on these beacons a plane can establish its position every three minutes.

Navigating in Poor Weather

With the use of the plane DF and ground DF stations, many combinations are possible and it is no trick at all to fly a very accurate course under any conditions. If static is so bad that no station can be read in normal flight, the following procedure is followed. The radio operator notifies the ground station of the conditions and requests a position. In a few seconds after the head ground station has had time to notify its secondary stations of the request, the operator in the plane sends out a series of long dashes so that the ground stations may take bearings on him. When the plane operator thinks the ground stations have had ample time to lay out the bearings he notifies the pilot, who places the props in extreme high pitch, pulls the throttles back and slows the plane down, at times even to a stall. During the time the plane is slowed down the static is reduced either entirely or enough so that the operator can read the ground station and in this brief period of time he receives his exact position at the time the bearings were taken. There is no such thing as a pilot being lost in Europe and it seems incredible to European pilots that it is possible for pilots over here to be lost under any conditions.

A System for Private Pilots

There is also a secondary system for the use of all planes but which is intended primarily for the use of private planes having only a receiving set. This is a series of navigation beacons that works in the following manner. A signal is set out over a rotating loop antenna. This loop rotates one time each minute and during that time gives two identification signals, one at a due true North heading and one at 90 degrees. (This is so that if the plane is due north of the station and receives the null at that time, the pilot can identify the station he is listening to on the 90 degree identification signal.) To use this navigation beacon the pilot simply tunes in to the station he wants, and when he hears the signal start after the identification signal at 360 degrees, starts his stop watch. When the signal fades out at the null he stops his watch and multiplies his time by six (the number of degrees the rotating loop turns in one second), and he has a true bearing from the station to his position.

For landings under conditions of low ceiling and poor visibility the pilot has three methods to choose from. He may land on the Lorenze short wave landing beacon, a long wave landing beacon (the same as the Lorenze except that there is no glide path), or by QDMs (magnetic courses to the field).

It is considered safe to land with QDMs when the ceiling is 50 meters or better and when the visibility is 500 meters or better, and since this method is much faster than beacon landings it is used under these conditions. When a pilot wishes to land with QDMs he notifies the ground station of his intention and requests continuous courses. From then on until he is on the ground he will get from four to six courses to the field a minute. He lets down to his minimum safe altitude and flies to the field. When he passes over, he is notified that he is over the field and has the double check of his courses changing 180 degrees. He proceeds past the field far enough to make a turn and lets down on the way back. As he approaches the field he is given "motor noise" South or whatever direction he is approaching from. The advantage of this system is that a pilot may always approach the field into the wind and never has to circle to land after he gets there. In cases where there is ample ceiling over the field to clear the surrounding obstructions planes may be landed easily and very quickly. The pilot simply comes in over the field from whatever direction he is flying, and when he is over the field lets down and lands.

There are several variations of this system but they all work about the same. In some cases there are two DF stations at the field, so the pilot not only gets his course to the field but his distance.

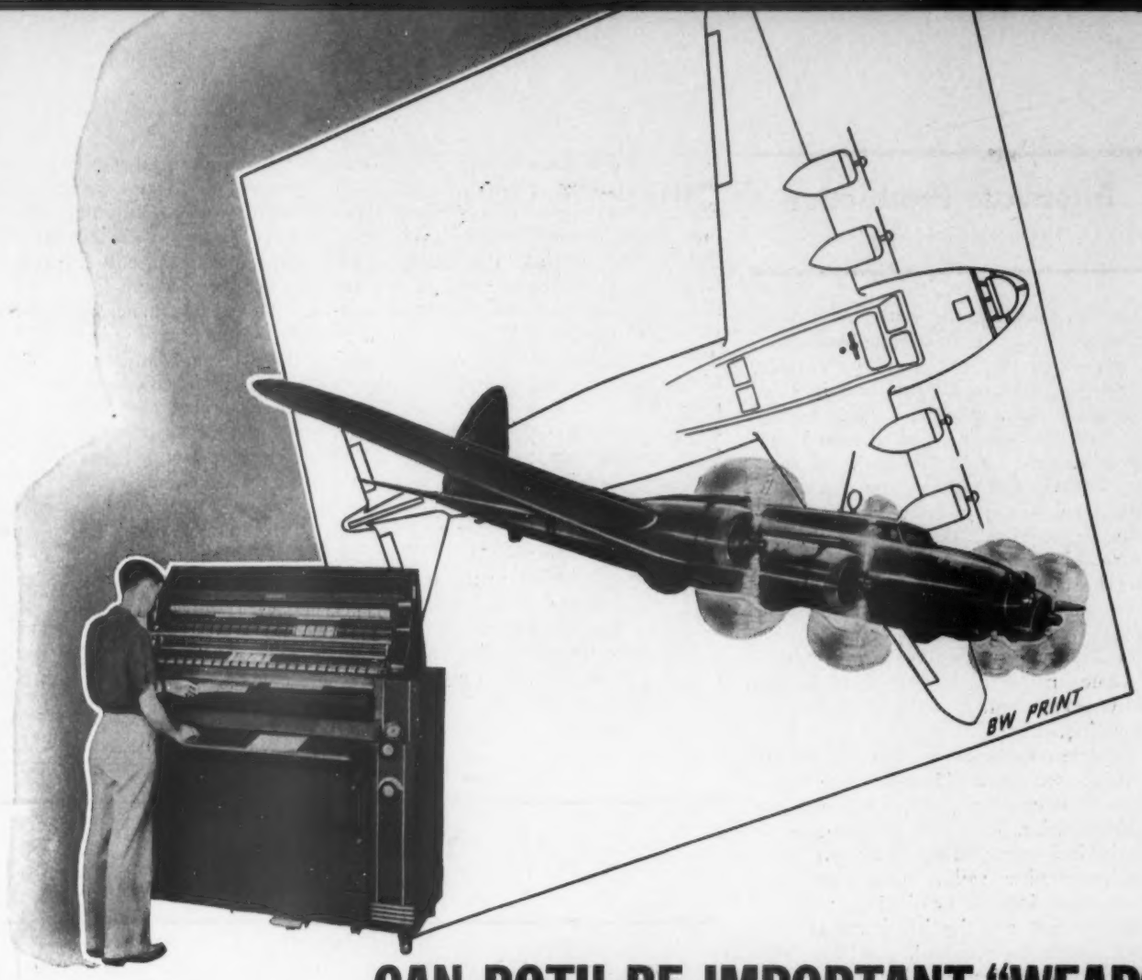
For landings with weather conditions less than the above, one of the landing beacons is used. The manner of landing by instruments is the same as has been done in test work in this country on short wave beacons, with the exception that the glide path is not used since it was found to be not 100 per cent reliable.

Air Traffic Control

Air traffic in Europe is controlled only within a radius of 25 kilometers of the airport, and then only when mist regulations are in effect (when the ceiling is less than 100 meters and the visibility less than one kilometer). During the time the mist regulations are in force the airport control officer instructs the pilot when to enter the control area and at what altitude to fly. The planes are stacked over the field 300 meters apart. There are no assigned flight levels for enroute flying, but planes are warned of the proximity of other ships. In the air they take bearings on each other and if the bearings change there is no chance of collision; otherwise they change altitude or direction by agreement.

Pilots do not report weather conditions except when passing from good visibility to instruments or vv. Of course such weather conditions as severe icing or thunderstorms are always reported.

There are no weather restrictions on flying in Europe—a pilot may and does take off and land by instruments if he thinks conditions are suitable.



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Interstate Production

(*Continued from page 65*)

automatically turning circular parts or fittings during the welding operation. This rotating stand is fully portable, holds the work at the proper height for easiest access, may be swung to any desired position by a pivot mount and may be set to hold the work in either horizontal or vertical position. An electric motor drive is used, operating through a friction disk and phonograph turntable and gear box, to drive the work support at any speed desired by the operator. Control is provided by a foot treadle unit borrowed from an electric sewing machine.

The entire fuselage is sand blasted after completion of welding and before priming.

Numerous shortcuts have been applied to wing assembly also. The spruce spars are purchased from the mill finished to size. They are then mounted in pairs in a spar drilling fixture on which is mounted a rolling drill press. All holes are located by drill jigs on the spar fixture, and the drill is rolled along the fixture as required, precision drilling all spar holes for wing strut fittings and drag brace compression members in a very few minutes.

Ribs are built up of riveted channel or "Z" sections of Alclad material. Top and bottom cap strips are of modified "U" section with side flanges and fabric clip grooves. Each cap strip is formed complete, except for drilling, in a single hydraulic press operation. These cap strips are then end-sheared and punched for rivet holes and fabric clip holes, using a special machine which punches 34 holes and does two shearing operations, with one stroke of the foot treadle. A pressure of 25-30 lb. on the treadle produces a working pressure of 1,730 lb. on the punches. The machine, by means of a simple adjustment, accommodates both the upper and lower cap strips, as well as the intermediate nose ribs, and aileron ribs. Fabric clip holes are punched vertically in the clip groove, and rivet holes are punched horizontally from each side of the rib "U" channel. One man can punch enough ribs for ten planes per day on this machine and this production could be tripled, it is estimated, by operating the machine with an air cylinder.

Wings are assembled in pairs, mounted back to back on a rotatable assembly fixture which provides the fullest possible access to both wings at all times and in any position.

Numerous features have been developed in the final assembly department to speed production or add to the ruggedness or ease of maintenance of the plane. Fuselage fairing strips are 1,020 steel channels tack welded direct to the structure. Seats are welded steel tube structures which fit into the fuselage for maximum strength, yet are quickly removable. Engine switch, fuel valve controls, and tab control are all placed in the ceiling for ease of attachment, ease of maintenance, and easy accessibility to both pilots. The cabin door is built up of spruce and plywood for rigidity, light weight, and serviceability. The fuel tank is of unique type, being assembled from two aluminum alloy halves formed in a drop hammer and welded into a single piece of oval cross-section. There are no baffles in the tank, since the form reduces slosh to a minimum and does not require internal supports for structural reasons. Not only is such a tank cheap to manufacture, but it is unusually light in weight, and rugged in service. Furthermore, no special fuel pump is needed to assure every last drop feeding into the fuel line, since the tank shape automatically directs all remaining fuel into the outlet, which is located at the lowest point.

There are numerous additional production methods used of which the above examples are illustrative. One process we have taken more or less directly from automotive finish shops is the practice of spraying our dope by a special method which produces a very fine finish of hand rubbed quality, just through the use of the spray gun.

No doubt there are a great many production ideas which have not occurred to us yet. But we have made a start in the right direction, at least, and just as fast as we can we will apply all new methods, or applications of old methods, which promise to give us better airplanes, quicker.

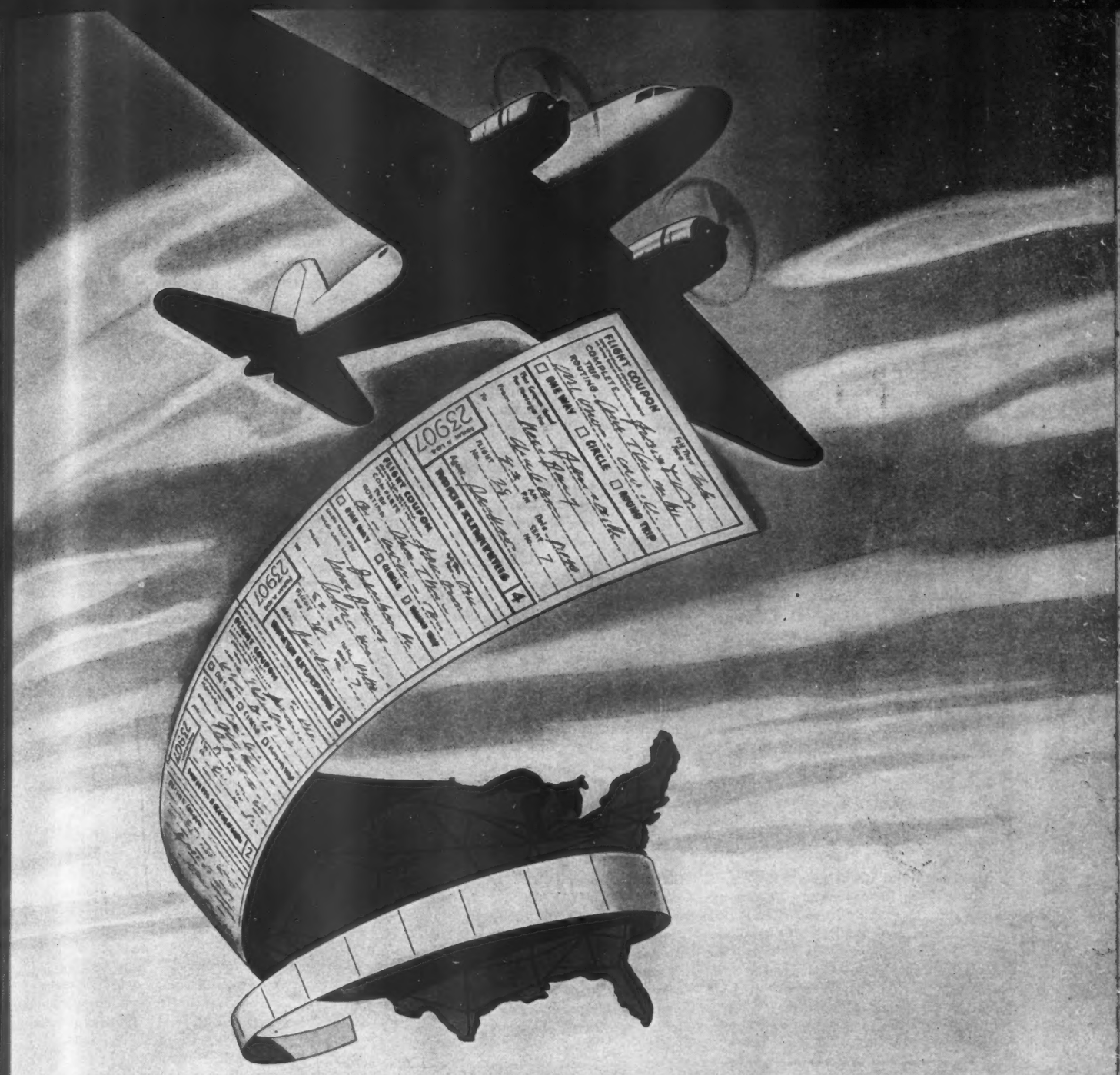
Taber-Van Dusen

(*Continued from page 71*)

is not possible for more than a limited few men to work around a loft layout at any one time, and the period required to produce a series of assembly fixtures frequently mounted up to many weeks or months. Various methods have been tried for reducing this time-consuming process, including development of wood or metal templates from the loft lines, such templates then being used for reproduction of a series of assembly fixtures. Another process has involved the use of photography, achieving some time reduction through employment of a monster camera to photograph loft lines and then print duplicate layouts on sensitized table surfaces to which the form blocks are then attached. These various efforts have been an improvement over earlier methods, but they left much to be desired in the way of further reduction of time spent in building fixtures, and in certain other respects such as accuracy and cost of equipment. Development of the Taber-Van Dusen method of duplicating loft lines on assembly fixture layouts has proved so successful under actual production conditions that it is now in use throughout the huge plant of Consolidated Aircraft Corp., San Diego. The process has proved thoroughly satisfactory from the standpoint of absolute accuracy, low cost, and ease of operation with relatively unskilled help, and without the use of elaborate or expensive equipment. Tests have shown a reduction in time of duplicating certain assembly fixtures, in favor of the Taber-Van Dusen method, of from 3,000 man-hours originally required to only 400 man-hours.

By the new method, utilizing the principle of reflection printing, a full-sized negative is made direct from the original lofted layout. This is done by placing the original loft board in a dark-room, laying a full size sheet of a special rigid sensitized translucent material over the board, and exposing it to light. When the sensitized surface is developed the result is a full-sized negative of the original board. From this can be made as many exact prints of duplicate layouts as are desired. These prints are made directly on the fixture tables, in the dark-room, and they are then all available at once for attachment of the positioning blocks. By this method the master pattern for block location on each fixture board can be printed with extreme rapidity on as many boards as are required. The position blocks, in turn, may be provided in any multiples needed and can then be fitted to the lines of the print with great speed and accuracy. The materials for the Taber-Van Dusen method are inexpensive and the only apparatus needed is a dark room. The process is adaptable to any industry requiring accurate reproduction of layout fixtures in considerable numbers.

The vital importance of this development to the present problem of speeding aircraft production will be apparent.



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DOUGLAS

AIRCRAFT CO., INC., SANTA MONICA, CALIF.

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German Production

(*Continued from page 45*)

many of the machines had been built especially for the mass production of the parts they were turning out. A considerable number of the multi-speed and semi-automatic lathes had been manufactured in a large machine tool factory belonging to the firm. Practically all of the machines had individual drives and the tooling was extremely up-to-date. No shortage in machine tools was being experienced as a special factory had been assigned to supply them.

The control department responsible for the quality and the quantity of the engines produced was divided into four sub-departments: Controlling the raw materials and complete assemblies received from outside sources, the working appliances including tools and dies, the production and inspection of the engine parts, and the assembly and testing of the engines. All of the vital engine parts were being inspected after each stage of manufacture to ensure perfection and interchangeability and to prevent waste. The inspectors had received special training in a technical school at the factory and each of them was a specialist for a certain range of parts. Extensive use was being made of electrical measuring apparatus which was quick and practically fool-proof in operation.

Both men and women were employed in the engine factory, with the women doing the less skilled work. That the management had studied the convenience of the employees was evinced by the large containers of hot water (for tea) and coffee inside each building. Twice a day small electric lunch wagons pulling trailers piled with soft drinks and edibles passed along the aisles. No objection was made to a pause for refreshments provided it did not interfere with the work.

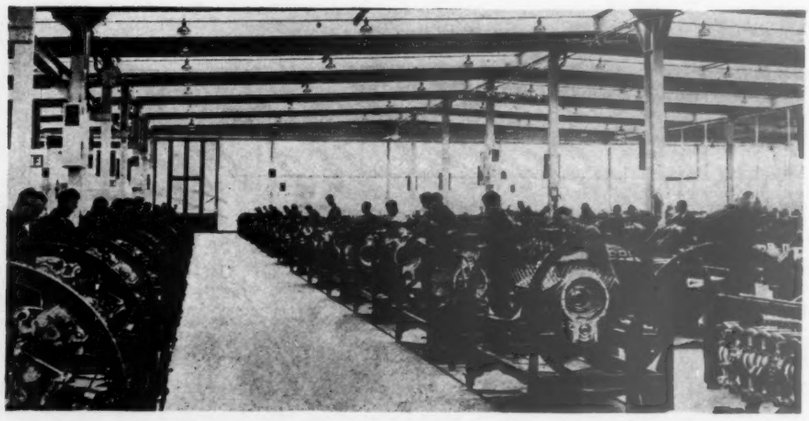
The training school at the factory at Dessau was particularly interesting inasmuch as it had received the highest award of the German Labor Front for professional training in 1936. At the time of the author's visit, more than 600 boys from fifteen to seventeen years of age were taking an apprenticeship course to become mechanics. Over each boy's bench was a card showing his name, age and personal history, the date he entered the training school, and curves showing his weekly progress and the quality of his work. In another department men from overcrowded professions such as barbers, carpenters and waiters also were taking a mechanic's course. These men were being prepared to earn a good living in a field in which there was a demand while at the same time a greater volume of business was ensured for their former competitors.

In another part of the factory was the veterans' department, in which skilled employees past the retirement age could continue to work if they desired to do so. In this department scale models of engines and airplanes were being constructed for exhibition purposes, together with cut-away engines with moving parts and sectional models. Everything was made easy for the veterans and they could smoke at their work and rest when they felt inclined.

The dining rooms for the employees were spacious and well furnished, and the food was plentiful and wholesome. Provision was made for everyone to have a hot meal at lunch time and the meals were priced very low as only the cost of the food was charged against them. In the dining rooms there was a raised platform from which musically inclined employees could entertain their fellow workers during meal time. Separate dining rooms were provided for the children of working parents so that the latter would not be worried about matters at home. The kitchens supplying the dining rooms were models of cleanliness and they were air conditioned.

In Germany, it is the belief that the people should have a healthy, care-free and positive outlook on life. This belief was reflected in the shops and offices of the Junkers factories where everyone seemed to have the feeling of being at home at his or her work. After all, most people will be content if they have a steady job amid good surroundings and the knowledge that the interest of the management in them does not end at the factory gate.

Part III of this article describing the production of diesel aircraft engines in the Junkers factories will appear in a subsequent issue of AVIATION.



The final assembly lines in the Junkers engine factories are equipped with rotatable engine stands which move down the flow lines until the complete engines are taken out. Many thousands of 1,200 hp. Jumo 211 engines have been built in this manner for the German Air Force.

Foreign Engines

(*Continued from page 68*)

General des Moteurs AVA of Paris, it did not become known until recently that certain exemplars have completed over 1,000 hours in the air without any important part requiring replacement.

The AVA 4 A-00 develops 25 hp. at 2,250 r.p.m. Its total weight (including attachment sheets and the hub of the propeller) is 37 kg. It was mounted with an interior pipe in the two-seater *Gaucher*. The design is built under a license granted by M. Violet who is known for his years of work in developing two-stroke engines. Since the sponsor of the engine is M. Jean Aubry, known to have been associated for some time with firms dealing in light alloys, it is not surprising that the design features the use of austenitic cast iron, tisalium and nitrided steels.

An obvious effort to create something mechanically strong yet simple, this French engine is based on the principle that the "two-stroke" reduces the number of moving parts and makes possible a reduction weight, even of the essential parts. In corroboration it is pointed out that even the crankshaft (of nitrided steel) is of one piece.

The four offset cast-iron cylinders of this air-cooled opposed type have a 70 mm. bore and stroke; cylinder displacement is 1,080 cubic cm. With the rated output as stated above, the maximum is said to be 28 hp. at 2,800 r.p.m. An American source informs us that fuel consumption is .66 to .715 lb. per hp.-hr., and the weight 81.5 lb., with overall dimensions of 21.65 in. in width and 21.36 in. in length. Reverting to

(*Turn to page 126*)

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distances still count

It is a far cry from the creaking, lumbering conestoga wagon to the sleek smooth-riding aircraft of today. In terms of time, distances have shrunk almost, but not quite, to the point of becoming inconsequential. Despite the speed with which ground can be covered, *distances still count* in the production of aircraft as they do in the manufacture of every commodity.

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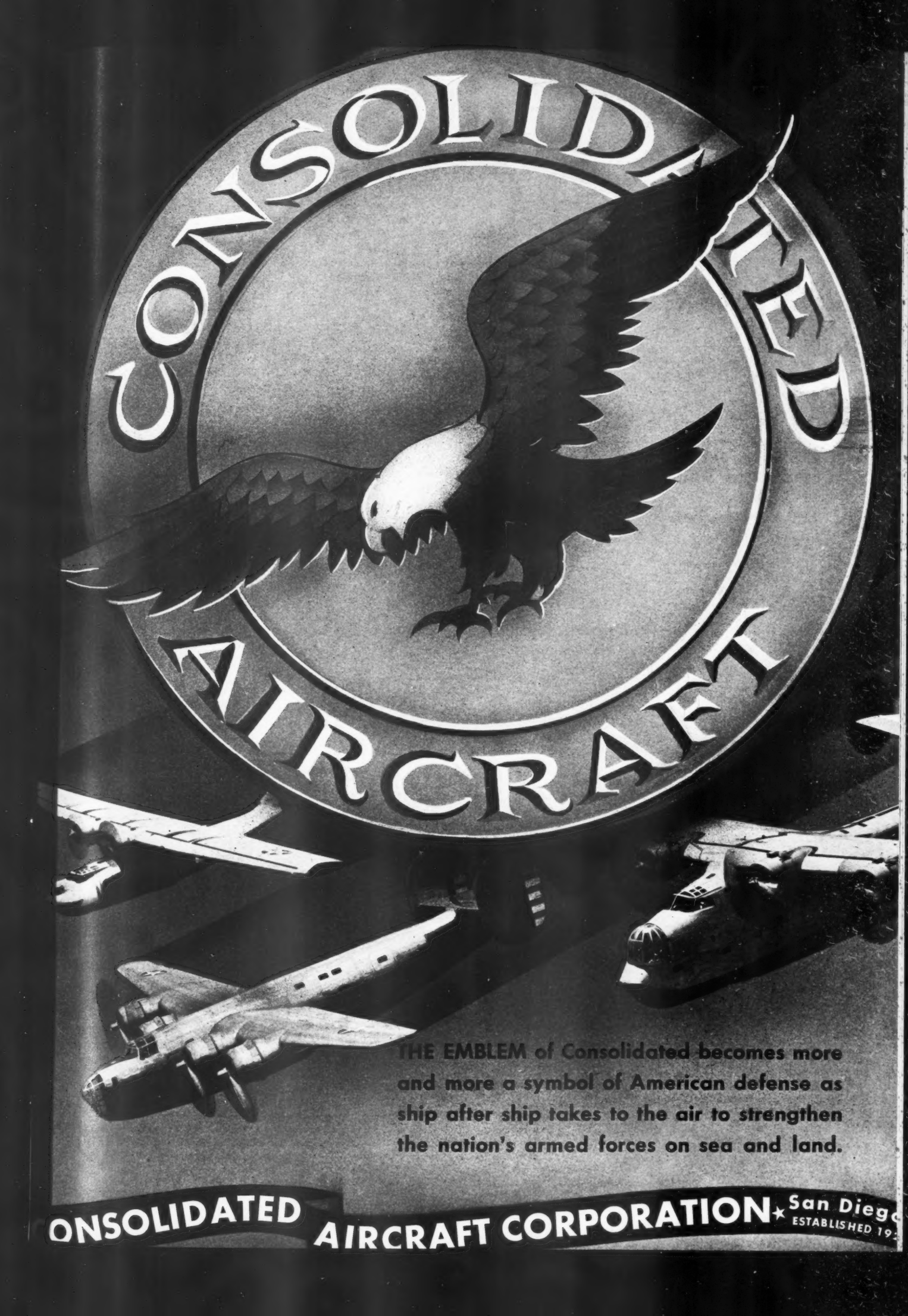


THE EMBLEM of Consolidated becomes more and more a symbol of American defense as ship after ship takes to the air to strengthen the nation's armed forces on sea and land.

CONSOLIDATED AIRCRAFT CORPORATION ★ San Diego ESTABLISHED 19

(*Continued from page 122*)

our French data, we are told that the ground-plan of the engine occupies an area of 55 sq.cm.

A special gas distributor of the rotary type, driven at one-half engine speed through gears from the rear end of the crankshaft, feeds the mixture to the cylinders in proper sequence. The mixture is produced in an *Amal* carburetor bolted to the manifold at the bottom of the crankcase. The carburetor is furnished with air control. The patented features include transfer ports through which the mixture passes. This particular scheme of mixture control, it is claimed, obviated one of the principal difficulties of the two-cycle principle of operation; th consumption figures above are cited as partial proof.

Also acting as an oil pump, the gas distributor forces the lubricant to all bearings. The crankshaft is made in a single piece of nitrided steel and is supported between the two halves of the vertically split light alloy crankcase. The connecting rods have shanks of H section, with roller bearings supported at their split ends. Ignition is provided by two magnetos mounted crosswise in the plane of the cylinders at the rear.

What the status of this engine and of its production has been since the German march into France is not known. Before the war, A. B. Gibbons of London had been licensed to produce the AVA engines in Britain.

Nomogram for Beam Columns

(*Continued from page 62*)

includes on the left side of the x_m/j line a scale of D_m/D_1 calculated by means of Eq. (4). When D_2/D_1 is larger than unity, the nomogram still holds if D_1 is specified to be the larger of the numerical values of D_2 and D_1 and x_m is measured from that end of the span having the larger numerical value of D. When the larger numerical value of D occurs at the right end of the span, it will be advisable to indicate this divergence from the usual notation by priming D_1, D_2 and x_m.

Since Eqs. (4) and (5) are of the same form, the double scale in Fig. 1 used to solve Eq. (4) also serves as a solution of Eq. (5) if $-D_m/wj^2$ and $1/2j$ are used instead of D_m/D_1 and x_m/j respectively. Since the x_m/j (or $1/2j$) scale is rather compressed at the upper end a magnified scale of $-D_m/wj^2$ and $1/2j$ (outer left scale in Fig. 1) has been provided so that values of $1/2j$ less than 1.2 can be read with greater accuracy.

Example: The following data for the outer bay of a two-span beam-column was taken from page 82 of reference 1:

$L = 96$ in., $j = 48.5$, $L/j = 1.978$
$wj^3 = 21{,}202$, $M_1 = +10{,}800$ in. lbs.
$M_2 = +3{,}999$ in. lbs.
$D_1 = 10{,}800 - 21{,}202 = -10{,}402$
$D^2 = 3{,}999 - 21{,}202 = -17{,}203$ } (Eq.(1))

Since D_2 has a larger numerical value than D_1, $D_1' = -17{,}203$ and $D_2' = -10{,}402$. Hence $D_2'/D_1' = -10{,}402/(-17{,}203) = 0.605$. A straight line drawn from $D_2'/D_1' = 0.605$ through $L/j = 1.978$ (dotted line in Fig. 1) intersects the left scale at $x_m/j = 0.83$, $D_m/D_1' = 1.48$. Therefore,

$x_m' = 0.83 \times 48.5 = 40.2$ in.
$x_m = 96 - 40.2 = 55.8$ in. (55.8 in reference 1)
$D_m = 1.48\ (-17{,}203) = 25{,}470$
$M_m = D_m + wj^3 = -25{,}470 + 21{,}202 = -4{,}268$ in lbs. ($-4{,}246$ in reference 1)
$-D_m/wj^3 = 25{,}470/21{,}202 = 1.20$
$1/2j = 0.587$ (Fig. 1)
$l = 0.587 \times 2 \times 48.5 = 56.97$ in. (57.0 in reference 1)

References

[1]Niles, A. S. and Newell, J. S., *"Airplane Structures"*, Vol. 2, p. 62, John Wiley & Sons, 1938.
[2]Sibert, H. W.: "A Note on Beams Under Combined Side and Axial Loads", *Journal of the Aeronautical Sciences*, Vol. 3, No. 9, p. 332, July 1936.

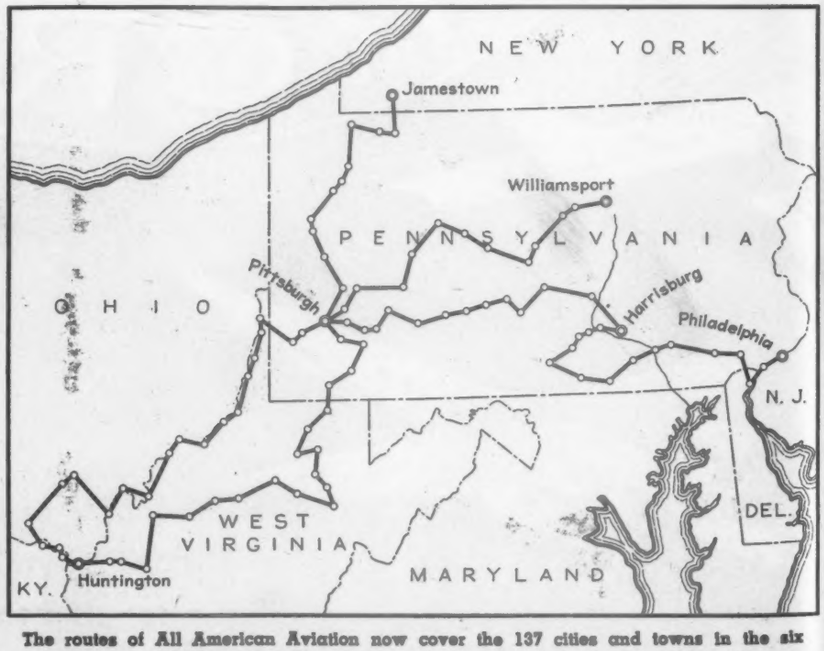
Air Mail Pick-up

(*Continued from page 46*)

new ground station have a metal base and a bamboo top which will not damage the plane if they are accidentally struck in making a pick-up. The ground equipment when not in use is stored in a specially designed box.

The routes of All American Aviation cover 137 cities and towns in six states (see map). Three are now in operation and service over the main two will start just as soon as the new equipment is ready, which is expected within 60 days. In addition an extension for the service has been requested from the Civil Aeronautics Board to include six additional cities and towns in Pennsylvania and one in West Virginia. The Pennsylvania communities are Lewistown, Carlisle, Shippensburg, Mechanicsburg, Newville and Newport and will be added to the route between Pittsburgh and Philadelphia. The West Virginia town is Ripley which would be included on the company's route extending between Pittsburgh and Huntington, W. Va.

If the proposed new routes are approved, a plane will leave Mechanicsburg every morning at 11:17 and arrive at Newport at 11:33 after making four pick-ups. In the afternoon a ship will leave Mechanicsburg at 3:28 and will arrive at Newport at 4:27. The town of Ripley will also receive two pick-ups a day.



The routes of All American Aviation now cover the 137 cities and towns in the six states shown on this map. The company has aggressive plans for taking in considerable more territory in the future.

BENDIX·RADIO

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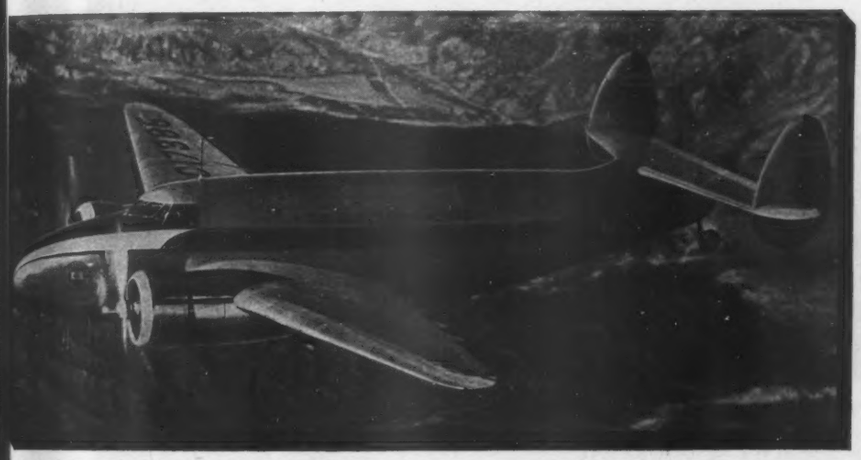
Delta DC-3's Also Equipped with Bendix Communication Units and Automatic Compasses



One of National's Fast, New Lodestars. National Airliners cover the important cities of Florida and the Gulf States as far west as New Orleans, and plans have been prepared to extend these routes in the near future. National is equipping their new Lodestar Fleet with Bendix RTA-1 Communication Units, RA-10 Auxiliary Receivers and MN-31 Automatic Compasses. Others using Bendix RTA-1 Communication Units are: Delta Air Lines; Eastern Air Lines; Transcontinental and Western Air; United Air Lines, and Major Al. Williams in his Gulf Oil plane.

5 Major Airlines Standardize on New RTA-1 Ten-Frequency Aircraft Transmitter-Receiver

The Bendix RTA-1 Transmitter-Receiver was conceived by the airlines and executed by Bendix in cooperation with Aeronautical Radio, Inc. (ARINC SPEC 508-A.) It consists of a ten-channel, 50-watt transmitter and ten-channel, crystal-controlled receiver, complete in one unit, with built-in power supplies, facilities for local or remote control. It weighs less than 75 pounds, occupies less than 2 cubic feet of space.

C. White, Supt. of Communications, National Airlines, who chose Bendix Equipment and systems. Centralized control units were specially designed by Bendix in cooperation with Mr. White.

G. T. Baker, President of the National Airlines. National's recent purchase of Bendix Automatic Compasses, Communication Units and Receivers for their airliners which fly 3,276 miles daily adds another important company to the growing list of airlines using 100% Bendix Equipment.

The Delta Air Corporation is one of the oldest, continuously operating organizations of its kind in the United States. Its 14 new Douglas Transports regularly fly the Delta Routes in the Southern States between Atlanta and Dallas. These airliners are among the many being equipped with Bendix RTA-1 Transmitter-Receivers and MN-31 Automatic Compasses.

FLASH!!!

Pennsylvania Central and Northwest Airlines, Purchase New Bendix MN-31 Automatic Radio Compass

(left) **L. T. Campbell,** Superintendent of Communications, Delta Air Lines; one of the men responsible for the selection of Bendix RTA-1 Communication Units and MN-31 Automatic Compasses for use on Delta Airliners.

Die Casting

(*Continued from page 56*)

die partings and where the cores which form the bores of the tubes come nearly but not quite together. To duplicate this piece by the use of wrought tubing would require: cutting five lengths of tubing, four of them having one end shaped to fit the main tube; cutting openings in the main tube where branch tubes enter; machining end fittings, probably in a screw machine; and welding the seven parts together, probably in a jig to hold them in correct relative position. All this would be rather costly and require far more time than to produce and finish the die casting. The part might be sand cast, but would be difficult to core and probably would necessitate much heavier sections and require more machine work than the die casting, besides being slow to produce, using sand cores and sand molds, each made individually.

A part forming a portion of a shock absorbing device for flaps, as shown in Fig. 2, is a very simple die casting, also in aluminum alloy, most of the sections being about $\frac{1}{8}$ in. thick. An equivalent part made from sheet metal parts welded together is said to have cost $5 each, whereas the die casting cost 53 cents per piece. The only machining needed on the die casting is to remove flash and drill the holes. To produce by welding would require, besides welding and drilling, the cutting of blanks and some forming operations on same, probably including some dies to do these operations economically, and a jig for welding. The die casting evidently serves as a structural member but doubtless is not heavily stressed.

Still another aluminum alloy part which is simply produced by die casting is the reading lamp base, Fig. 3, the cost of which, to the purchaser, is 23 cents each. This part is reported to have cost $12 per piece in welded form, which is seemingly rather high unless, as is likely, it includes amortization charges on stamping dies needed to blank and form the curved flange and the tubular portion which may have required one or more drawing dies. In any event, the die casting, besides costing far less, is ideal for such an application.

Among the many magnesium alloy die castings, the manual drum or wheel for control cable, Fig. 4, is fairly typical. Fabrication, except by casting, in a design such as this, would be exceedingly high if not prohibitive in cost. A sand casting would necessitate much machine work and probably be much heavier than the die casting which, though 9 in. in diameter, weighs $6\frac{1}{2}$ oz. and needs, apparently, only reaming of the hub hole and a saw cut through a section of the drum. Helical cable grooves or threads can be cast on drums but may require a light chasing cut to make them as smooth as required and to remove flash where that portion of the die which forms them is split.

Several other die cast parts in magnesium and in aluminum alloys for various aircraft applications, all produced by the Harvill Aircraft Die Casting Corp.

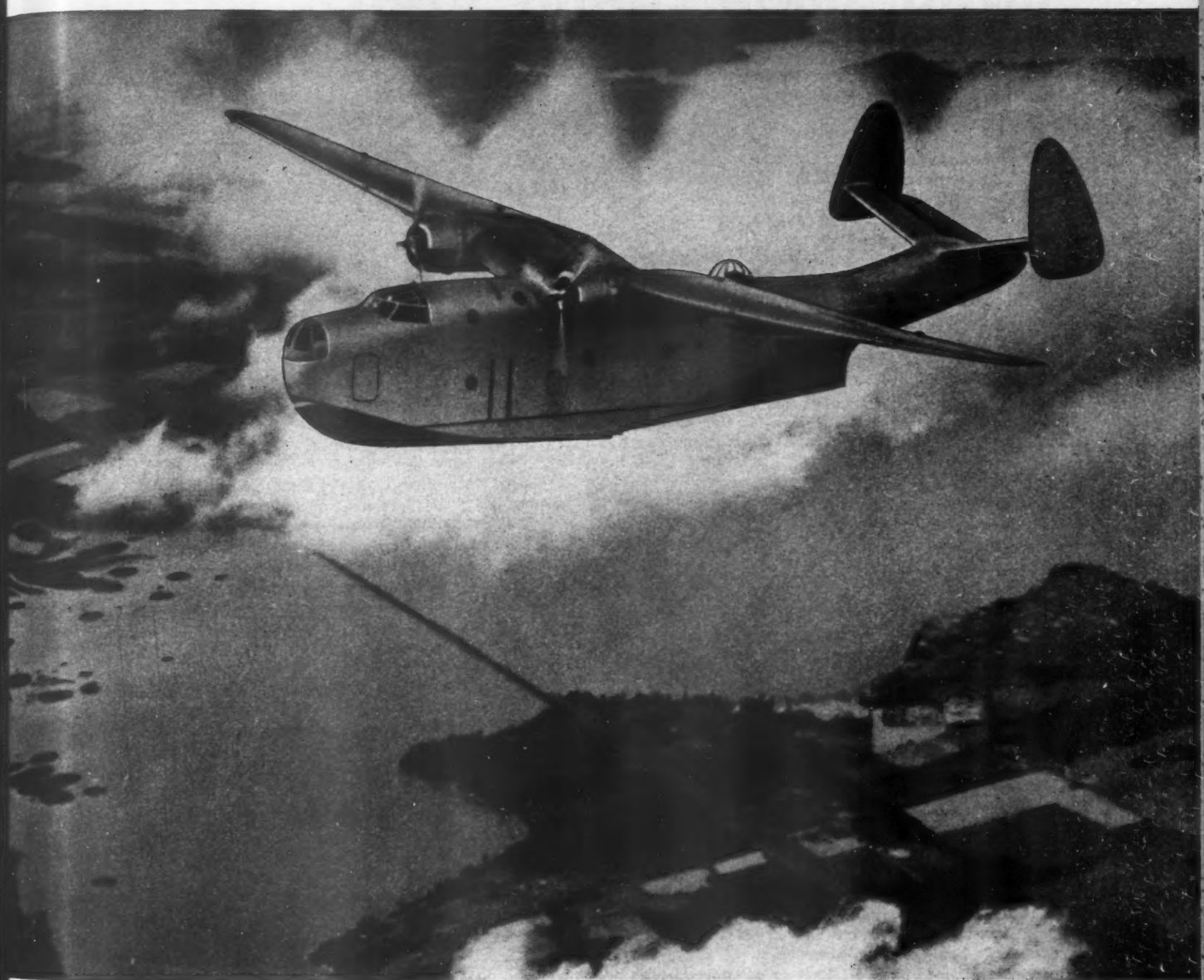
Not all the die castings used in aircraft are for small parts, although the number under 12 to 15 in. in major dimensions greatly exceeds those having some dimensions greater than this. Among the large die castings made in the plant whose products are here described, control pedestals deserve special mention. One such, produced in aluminum alloy. Fig. 5 measures $23\frac{1}{8} \times 4\frac{1}{2} \times 6\frac{1}{2}$ in. and weighs 5 lb. The outside is box-like and averages about $\frac{1}{8}$ in. thick, but there is a longitudinal web with bosses and cored openings and several cross-ribs at right angles to the web, all of which make for rigidity. It is doubtful if this casting could be produced in so thin a section in a sand mold and, even if it could be, it would not have the accurate dimensions of the die casting and would require a great deal more machine work, besides lacking the smooth surfaces of the die casting.

Another control pedestal, Fig. 6, of quite different design, made from a pair of die castings in magnesium alloy, weighs, when assembled, only 3 lb. It is $29\frac{1}{2}$ in. long, $7\frac{3}{4}$ in. wide and 5 in. deep, over all, after assembly and has various mounting bosses, flanges and extending parts, all cast integrally. Only 500 of these were required and the die was charged off at the rate of $3 per pair of castings, the price of which, including this charge and ready for use was $15.25, with all machining (of which very little was needed) completed. The corresponding charge for an unmachined sand casting was $8.72, including 32 cents per casting charged off for pattern casts. But after the sand casting was received it required 80 hours to machine it. At $1.50 an hour this machining cost amounts to $120 per casting, making the total cost $128.72 per casting, or more than eight times that for the die casting. Although this may well be an unusual case, it gives an idea as to what can be done and shows how savings in machining costs can very quickly offset costs for die work. Once the die is made and charged off, if repeat orders for castings are received, the savings are further multiplied, as die upkeep is very small, especially so for the relatively short runs which even large orders for aircraft parts entail.

Among the many other die castings for aircraft which might be described if space permitted and which have resulted in economies and speed in manufacture as well as in products well suited for their purpose may be mentioned the following: In magnesium alloys: carburetor air scoop valve, parts for bomb release mechanisms, aileron and brake pedals, junction box and cover for electric units and control pulleys in a variety of shapes. Some such pulleys or drums are made also in aluminum alloys as are also bomb rack anchors, control assembly base plates, and cable fairleads, cockpit inclosure parts, brackets of various designs, air intake check valves, and hydraulic valve parts, the last named taking the place of screw machine products with a saving given as 25 percent. Parts produced as manganese bronze die castings include small angle brackets and also clevices.

In some cases, die castings are strengthened by steel or other inserts which also provide greater hardness than die cast metals afford. Insert can be cast in place, if desired, or applied after casting. This practice adds to cost but is amply justified on other grounds in certain instances and may well be extended as designers become better acquainted with the uses to which die castings can be put economically and with assured success.

SEA POWER
IN THE AIR



Off the assembly line on regular schedule now are these powerful cruisers of the air—the Martin PBM-1 patrol bombers. Soon a new Navy squadron will be ranging far at sea, ever watchful of our national safety; ready to summon a mighty force if ever that safety is jeopardized; ready to strike a heavy blow when need be. ★ Carrying a normal load of 40,000 pounds, packing the power of 2,700 horses in its pinions, which measure 118 feet from tip to tip, these new Martin flying boats are able to perform distant patrol missions separately, or attack in force as a group. Information on armament is restricted, but visible on each of these are four turrets. Heavily gunned, they can be approached only with utmost respect. ★ With complete living accommodations for its crew of seven; with efficient auxiliary electric power plant, heating, sound proofing, ventilating, and deicing equipment, the PBM-1's are designed to operate from fixed bases or with the fleet at sea. ★ Truly, this fleet of the air will be an important adjunct to the fleet of the sea.

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TRADE MARK

MARTIN

Machine Loading

(*Continued from page 55*)

But Mr. Hamilton and others who studied the problem saw that while this effort was more effective than what was done before, there was real need for the shops to chart their loading themselves. As independent entities, doing business with the industry as a whole, faced with the need for greater control over their expanding operations, and in fact possessed as no one else with the basic information concerning their operations, it appeared that they should assume the responsibility of setting up their own means of controlling their loads. While it would be of advantage to the buyers for the shops to establish a uniform method of charting their loads, the fact remains that the organization of the information involved, the charting of it and analysing it, represents a major step by the shops in keying up their management to the requirements of the new situation of intensive preparation for national defense.

By the recent organization of the Southern California Aircraft Parts Manufacturers' Association, the job shops of this area have signified their realization of actually becoming manufacturers.

These parts manufacturers are already recognizing that the methods of former days no longer serve. With the opportunity already here of making parts by the hundreds and thousands instead of by the dozens, shop executives have been working on the problem of getting organized for real production. Both the men who have brought with them from other industries the experience of mass production, and those who have grown up in the aircraft industry, are getting hold of that abstraction, functional organization.

They know that one man cannot do everything when the job gets so big. If one man has to concentrate on operating the shop, getting out work on the machines, supervising the men, training new ones, then someone else must take off his back the burden of doing the paper work, checking orders, finding out whether tooling and material are available, and bothering with follow-up men who have been bedeviling him with demands for parts or promises. In fine, this hectic situation of the first six months of 1940 brought closer to everybody's minds the fact that the time has come when shop organizations require division of responsibilities for functioning.

Fundamentally that means thinking about the problem, and then planning. If the shop man still ties himself up with operation, then he may need an engineer to help him plan the coordination of these divisions of functioning. He may need an engineer to help him do some of the planning, which has to do, among other things, with layout of shop, and manufacturing methods. But the most universal need for planning work comes in connection with the flow of orders, which must be controlled, and uninterrupted, so far as it is humanly possible to make it.

It is necessary to establish some simple means whereby buyers and shops can maintain an up-to-the-minute picture of the available capacity of the various groups of machines, and how much of that capacity is being filled for work to be done this week, next week, and every week for months to come, with relation to promises made to meet delivery dates. The device best creating this picture is generally known as a loading chart, which clarifies in everyone's mind how many man-hours or machine-hours the shop has to sell, and at what time, on the different types of operations. It serves to make sure that the shop capacity is sold in full, not oversold or undersold.

The old way, on small scale production, was to build up a backlog, and to run orders whether due today or next year. The new way, on larger scale production, is to try to get in orders due now to fill in current gaps in the schedule, and incidentally to obtain the reasonable extra return for making immediate deliveries, before filling those gaps by running orders calling for future delivery. To organize to do this requires a loading chart.

Someone in the shop must be responsible for knowing how many man-hours of unfilled capacity it has to sell on various operations for any calendar week. The buyer needs to know it, and can benefit by having a weekly blueprint of the loading chart in front of him. He has no time to call up and ask someone's opinion of whether the shop can do work on time next week, next month, or for the next six months. He has orders in front of him he wants to place now. He is going to give preference to those shops which cooperate by keeping him informed systematically of their production schedule.

Further, the shops are no longer satisfied to wait until someone decides to place an order to find out whether the tooling is in, the material satisfactory, the information available. Some of them are seeing to it that as soon as the chartsman analyzes the incoming orders he shall also find out if everything is available to put the order in work. In other words, he must chart live load as well as theoretical, and he is in a strategic position to set in motion a follow-up of missing parts or tools or data, saving precious days over the old method of waiting until a machine is down and waiting for work. This helps to assure that the orders flow into the shop on time. It helps operation supervision free itself to concentrate on supervising operations. It helps meet the situation that, while supervision could successfully plan the work last year, with work multiplying tens and hundreds of time this year, and no corresponding supply of men available to augment supervision, the thing to do is to relieve supervision as far as possible of every detail not connected with direct operation.

Many of the shops are going further. In addition to loading charts, which nozzle the volume of orders into the shop for weeks to come, they are setting up machine schedules to plan and control the loads of the machines for this week and next. It becomes further unnecessary for supervision to hunt for jobs for particular machines.

If a job can be estimated, its operations can be broken down and planned. If operations can be planned, they can be scheduled. And this is being done. It calls for simplicity of set-up. It requires an unusual degree of flexibility in procedure in the aircraft parts industry. But just as loading charts clarify the picture of filling of the shop to capacity, the schedule of the work on the machines clarifies the picture of the current operation. Orders do not become lost or kicked around. Promises made become promises fulfilled.

Furthermore, by this intelligent organization of work, the shop assumes its rightful control of the situation. When work is more or less piled into the shop like coal into a bin, the result is that the follow-up men from the factories are forever stirring up the pile, hunting for orders they have been told must be gotten out, and disrupting the efforts of the shop, however disorganized. But with an attempt to set up and maintain within reasonable bounds a proper scheduling of the work, the shop is showing the follow-up men in advance why errors of omission on the part of the factories are holding work back. It is placing on the factory, where it belongs, the responsibility for correcting errors or shortages which in the past have been the cause of much of the confusion. It is bringing to light in an intelligent manner the possibility of putting through work thrust upon it with the demand for immediate performance when already there are too many orders on hand now due ahead of it.

There is no doubt that loading charts will be of increasing importance.

(In an article in next month's issue Mr. Parsons will deal with practical charting methods.)

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Previous Schooling .....

Finch Facsimile Demonstrated

(*Continued from page 48*)

range employed lies in the range from about 400 to 2,400 cps, coinciding with the limits of ordinary telephone circuits.

The demonstration showed that virtually any type of written or printed matter can be sent or received by the machine, including such military items as sketches of artillery positions, weather maps and storm warnings, written orders and reports, and even photographs. The detail of the received copy is about 100 half-tone dots to the inch, plenty fine enough for any but the most exacting reproductions. The speed of operation is fast; the received copy is printed at a rate of about 8 sq. in. to the minute. If the message is transmitted from typewritten copy, this means about 75 words per minute, or 150 words per minute if from fine printed matter. Even the first figure mentioned compares favorably with voice communication, with the important advantage of the written record, plus the fact that the recorder requires no attention or skill in operation. The size of the duplex unit is 14⅞ x 13¾ x 12¾ in. With it is required a battery box and oscillator, which weighs about 15 lb. The equipment may be operated from any of the standard types of power, 6, 12, 24 or 32 volts d.c., 110 or 220 volts d.c., 50 cps ac, 60 cps ac, or from batteries.

Transmitting Mechanism and Circuits

The duplex unit contains two rotating drums, one for transmitting and one for receiving. The transmitting drum around which is wrapped the copy to be transmitted is rotated at about 100 r.p.m. by a battery-driven or a.c. motor. Parallel to the axis of this cylinder is a feed screw, geared to the same motor, which drives the scanning carriage. The carriage consists of three main elements, a six-volt exciter lamp of 50 cps., not unlike an automobile headlamp, an optical system for focusing the light from the lamp onto the transmitting cylinder, in a spot about 0.01 in. in diameter, and a phototube which receives the light after it is reflected from the surface of the copy. The carriage is displaced about 0.01 in. horizontally for each revolution of the transmitting cylinder. Hence the spot of light covers the copy in an endless spiral, at the rate of 100 lines per inch. The copy itself is written, printed or photographed, on blanks about the size of standard telegram, 8¾ x 7 in.

As the copy rotates past the scanning spot, the variations in light and shade covered by the spot are translated into corresponding photoelectric currents in the phototube. This current in turn is used to modulate an audio-frequency carrier of about 2,000 cps. This modulated audio-frequency carrier is in turn used to modulate the radio equipment, after suitable amplification to bring the output up to 6 milliwatts.

Synchronization is necessary in order to keep the transmitting and receiving drums operating in accurate step. In the Finch system synchronism is obtained by generating a separate synchronizing pulse at the end of each revolution of the transmitting drum. On the shaft of the transmitting drum is a cam operated switch which controls two circuits. One changes the frequency of the audio carrier voltage momentarily once in each revolution, while the other increases the amplitude of the carrier during the same interval. The momentary change of frequency and amplitude are caused to come when the phototube is scanning the boundary between the left-hand and right-hand edges of the copy, which meet when the copy is wrapped around the cylinder. This boundary is marked by a solid black metal bar which acts to hold the copy in place on the cylinder.

The electric circuits are simple. The phototube and its 5-meg load resistor are connected directly in the control grid of a 6K7 modulator tube (a 6J7 tube may be used if sharp contrasts are required in black and white copy). The audio-frequency carrier voltage is applied to the screen grid of the same tube. The audio-frequency output is thereby modulated in accordance with the phototube current and applied to a 6J5 voltage amplifier which raises the level to 6 milliwatts (zero db). The oscillator itself is located in the power supply cabinet, together with a buffer amplifier.

The scanning mechanism is fitted with four rotating control dials. The control at the left is the on-off and output level switch. The control next to the right controls the black level, that is the value of signal which produces black in the received image. The third control sets the level of the synchronizing pulses, while the fourth sets the modulator bias. By adjustment of these dials the value of the output, and the range of signal between black and white may be adjusted to meet the demands of the copy and the transmission circuit.

Receiving Printer

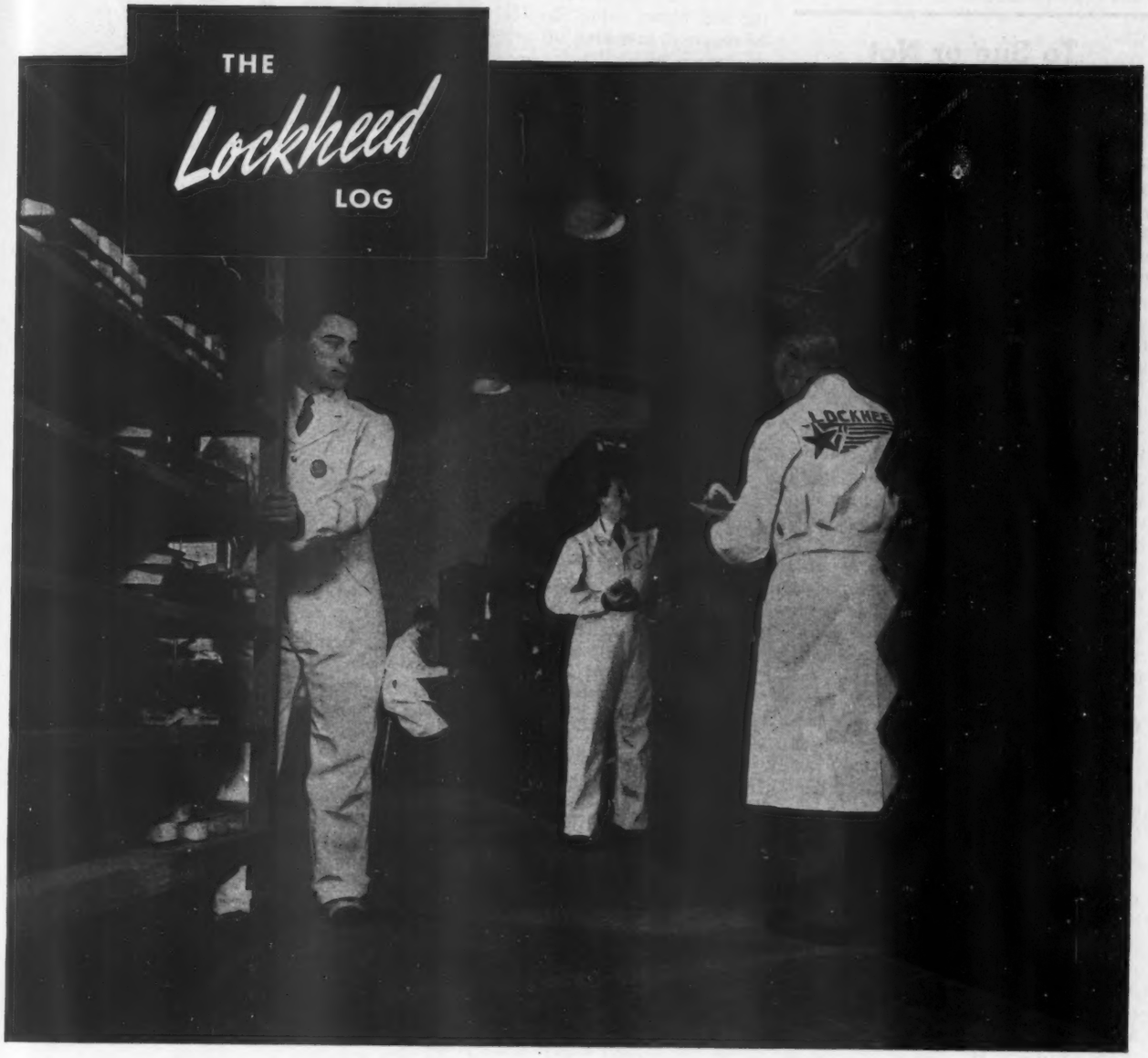
The forward drum in the duplex machine is the receiving counterpart of the transmitting drum. This drum may be used to receive copy from another station, or to monitor the outgoing transmissions, thus providing a written facsimile copy of all material sent and received.

The receiving drum is rotated slightly faster than the transmitting drum, and would accordingly exceed the rotation of the transmitter except that a projecting pin engages a stop of the receiving cylinder once each revolution, bringing it to a complete stop. When the synchronizing signal is received, it operates the solenoid of a friction clutch which starts the receiving drum off on the next revolution. In this way the two drums are caused to start off each revolution in step, and any lack of synchronism which develops during a single revolution is not great enough to affect the appearance of the received copy.

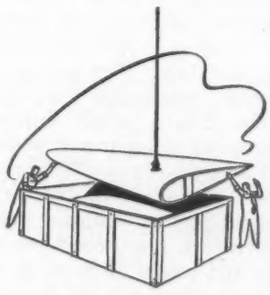
The copy is printed by means of a small wire stylus, about 0.01 in. in diameter which traces out an endless spiral on the receiving paper, exactly similar to the spiral covered by the scanning spot of light on the transmitting drum. Current fed from the receiver is passed through the stylus to the dry sensitized paper, and through it to the cylinder behind. The passage of the current causes the light-gray coating of the paper to burn off, revealing the black base beneath. Thus the lights and shadows perceived by the phototube at the transmitter are recreated at the receiver. Tungsten wire for the stylus has been found to have the longest life.

The receiving circuit consists simply of a 6N7 double triode tube connected as a double triode which rectifies the received modulated carrier and delivers to the stylus a varying current proportional to the phototube current at the transmitter. About five watts of input audio-power, average, is required at the input to the recorder, at the primary of a transformer, presenting an impedance of about 10,000 ohms. The secondary of this transformer feeds the double rectifier previously mentioned.

In operation the transmitted signal has complete control over the motion of the receiving cylinder, that is, the receiving cylinder remains motionless until the synchronizing signal is received, and it stops rotating as soon as the transmitter leaves the air. Reception is accordingly possible entirely without supervision, other than wrapping the sensitive paper around the cylinder and throwing the motor switch. The receiving paper is highly stable, requires no treatment of any sort, and can be handled roughly without showing wear or extraneous markings.



IT COSTS MONEY *to keep Airplanes on the Ground*



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LOOK TO *Lockheed* FOR LEADERSHIP

To Sue or Not

(*Continued from page 43*)

words, the court divides the air above one's property into two zones—that zone that an owner could use and that zone which could not reasonably be used. With such a theory, flight would naturally be tolerated at lower altitudes where the airport is surrounded by woodland or farms than if it were surrounded by a residential area or an industrial center. This theory, if adopted, might constitute a substantial detriment to Mr. Harry Worcester Smith's 300-ft. silo. For if the New England Aircraft Co., in our hypothetical case, could prove that the 300-ft. silo were really a spite obstruction and could not reasonably be used, that its height was beyond Mr. Smith's possible practical use, and that 300 ft. of upper airspace in dense brush could not be said to be within the reasonable possibility of man's occupation, Mr. Smith might be required to partially demolish his 300-ft. silo. But, assuming this theory were adopted and Mr. Smith was again forestalled, what would happen if our hypothetical airport were surrounded by closely located residences, or by an average typical American industrial district close to which the location of an airport would be desirable?

But we need not wander afar for in the same year, 1934, a similar case arose in Pennsylvania, involving the Sky Haven Airport. The airport covered approximately 65 acres and its longest runway was at right angles to the prevailing wind. Planes using the airport were required to fly over the property of one Mr. Gay at altitudes as low as 25 and 50 ft. Mr. Gay's property was north of the airport only 500 ft. Mr. Merkl, a second plaintiff, lived east of the airport, approximately 1,400 ft. away. Mr. Taylor, a third plaintiff, lived south and west of the field. One-quarter mile from the field was the fourth plaintiff, a hospital for consumptive diseases. Their complaint was typical. The airport was a nuisance because of noise, dangerous because of low flying, that there were great collections of crowds, there was blowing of dust, stunting over plaintiffs' property, use of powerful amplifiers, and that flight over plaintiffs' property was at from 10 to 300 ft.

In this case the plaintiffs found a sympathetic court. The court found that the airport was a private nuisance to the four plaintiffs and granted an injunction against its use. The court found that this case was similar to the Swetland case, using the same reasoning that planes using Sky Haven would be required, in taking off or landing, to fly lower than 500 ft. and therefore should be stopped.

This case, however, is not too significant since Sky Haven was undoubtedly a small field and undoubtedly constituted a nuisance because of low flying, dust blowing over plaintiffs' property, noise caused by warming up of planes, and crowd attraction. But the case is interesting from the point of view as to what could be done under the theory used in the Thrasher case against the City of Atlanta if Sky Haven covered 130 acres and the Thrasher theory were applied in a situation where residences were more densely situated. But again "Time Marches On" and in 1936 a further refinement was made to the Thrasher theory.

A Mr. Hinman who owned 72 acres of property in Burbank, Cal., claimed that planes owned by the defendants, Pacific Air Transport and United Air Transport Corp., flew over his property at altitudes lower than 100 ft. The plaintiff claimed that he was entitled to 150 ft. of airspace above his property which could not be invaded by anyone, and therefore flight at less than 100 ft. must be halted. The court, however, disagreed with this view and ruled that an owner of land owns only as much of the airspace above his land as he actually uses and the rest belongs to the world. The court did say that any use of airspace by others that is injurious to a landowner can be considered a trespass but the court refused to set any arbitrary limit or protect a landowner as to some unused airspace for some contemplated future use. As a matter of fact the court stated that it would sanction flight at less than 100 ft. if such flight did not impair a landowner from fully enjoying his property. The court refused to indulge in anything but realities and reserved to the landowner only that portion of the upper airspace that he actually used, and stated that flight at altitudes lower than 100 ft. would be prevented if such flight did impair a landowner's full enjoyment of his property. In such a case the landowner would be put to the necessity of proving such flight to be a nuisance.

This theory is a further refinement of the Thrasher theory since it refused to recognize as a part of a landowner's holdings the upper airspace which is within "the reasonable possibility of man's occupation and dominion," and becomes a very useful weapon against our Mr. Harry Worcester Smith and his 300-ft. silo. For if the New England Aircraft Co. could show that Mr. Smith could not actually make use of a 300-ft. silo and that it was built there as a spite obstruction, under the theory used in this Hinman case, it could probably get a court of law to compel Mr. Smith to demolish part of his silo. That the New England Aircraft Co. could successfully advance that argument seems to gain considerable support if we shift our scene of operations to Iowa City in 1936, at which time a Mr. Frew A. Tucker reached the decisive conclusion that the only effective way to stop an airport's activity is to do it yourself and not waste time in court.

Mr. Tucker owned a farm consisting of 47 acres. Adjoining the southern boundary of his farm the town of Iowa City built an airport and this airport was a scheduled stop on the route of United Air Lines. Mr. Tucker claimed there was deliberate low flying over his property, especially when planes were landing and taking off, and that on several occasions aircraft flew so low as to break off branches on trees located at the southern boundary of the farm. Mr. Tucker, being a man of few words but much action, planted a number of fast-growing poplar trees on his property along the northern boundary of the airport and threatened to plant similar trees on another portion of his land. The trees that he had already planted were 35 ft. in height. And presto! United Air Lines began to skip its scheduled stop at Iowa City. Without any delay, however, United Air Lines and the town of Iowa City instituted an action against Mr. Tucker for an injunction to prevent him from planting any further trees and from maintaining the trees already planted. It was a fight for life, at least the life of Iowa City's airport.

In the lower court Mr. Tucker fared pretty well. The court found that planes using the airport were causing inconvenience and danger to the plaintiff and damaged Mr. Tucker's trees. Without hesitation the court granted an injunction against planes flying at a height less than 50 ft. at one spot and 30 ft. at another. But innocuous as that ruling may seem on its face, it was sufficient to make use of the field impossible without disobeying the court's ruling. And so United Air Lines and Iowa City took an appeal. The court found that the trees would not constitute a proper enjoyment of the property and that any more than 25 ft. in height were an obstruction to air traffic. The court ruled that Mr. Tucker could not plant or maintain anything on his premises that would obstruct air traffic at a height of 50 ft. or more unless it was necessary for the enjoyment of the property and specifically ordered him, within fifteen days, to remove all trees over 25 ft. in height.

To be concluded in an early issue of AVIATION.